Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

Published by McGraw Publishing Company, Inc.

Volume 74 NEW YORK, SATURDAY, JULY 29, 1916 Number 5

Machinery vs. Labor

HARD on the heels of the editorial note in this journal of July 15, page 65, commenting on the compensating advantage of the war in forcing contractors to replace human labor by machinery, comes a letter from a Russian engineer, inquiring about American machinery for saving labor on construction work. He goes on to explain that the war has compelled them (in Asiatic Russia) to change entirely their construction methods, which heretofore were like those of India and Egypt. Manual labor was very cheap and the use of machinery was practically unknown. Now labor is scarce and the engineers are promptly learning all they can about labor-saving devices. Naturally they turn to this country. The inquiry indicates what a large field is being opened in Russia for American enterprise.

New York Buildings Restricted

NEW YORK'S building restriction ordinance which has been under discussion for three and a half years, and has involved an exceptional amount of investigation, including a study of the restriction experience of foreign cities, was finally passed on July 25 and at once became law. It marks a great forward step in American city planning. Other American cities have had building height restrictions and some even have had industrial segregation. The New York ordinance includes both, and in very detailed form. It recognizes the many factors that necessarily exist in a grown city, and imposes the restrictions with due regard to these factors. Height limitations vary from the width of the street in strictly residential districts to two and a half times the street width in the financial district. Tenement and apartment houses, in their proper zones, may go up to a height of one and one-half times the street width, while a rule of twice the street width applies to a large part of the more intensively developed commercial and industrial sections. Those who want further details regarding the restrictions will find them in the Engineering Record of Feb. 26, 1916, page 284.

Road Bill Not a Pork Measure

SOME NEWSPAPERS, though not many, have referred to the federal road-aid act as a pork-barrel measure. Far be it from this journal to defend the odious system of trading for votes which has made the river-and-harbor and the public-buildings bills notorious. In the ordinary sense of that term the road-aid bill was not a "pork" measure. Trading for the advantage of one's own district was out of the question, for the apportionment of funds was made by general rule and not left to the whim of Congress or to that of any government department. Furthermore, the expenditures are to be subject to close government scrutiny; the money is not freely turned over to the states to do with as they wish, as was proposed by some congressmen. The Engineering Record has not altered its position on federal aid—namely, that it were better to have the states do their own work without the aid of federal funds. Road-aid appropriations, however, were inevitable, and the act as passed seems to have provided all the safeguards needed.

Congress and the Railroads

APPROVAL of a Senate resolution by the House of Representatives on July 15 gives assurance that there will be an inquiry, by a congressional committee, into the railway transportation problem of the country. It will be remembered that in his last annual message the President suggested a commission to investigate "the exceedingly serious and pressing transportation problem." Though the House made certain amendments to the Senate resolution, they are of a minor character and there is but little doubt that the measure in substantially its present form will go to the President and that he will sign it. The house resolution requires that the report be rendered next January, a very short time for a very broad inquiry. The resolution indicates the scope of the investigation. It covers not only the matter of government regulation, but also the protection of the rights of shippers and carriers, incorporation of the transportation companies, and government ownership not only of railways but also of telegraph, telephone and express lines. It is gratifying to know that Congress has accepted the President's suggestion and will try to understand the railroad problem clearly before attempting further legislation.

Hogs as Waste Consumers

TO many municipal officials and to some engineers the disposal of garbage by feeding to hogs may seem like a simple process and one beneath the careful study of technical men. The article on page 135, describing Denver's successful hog-feeding plant, should convince them to the contrary. Thousands of dollars have been spent in Denver in experiments on comparatively unimportant details. Few methods of procedure or types of construction are now retained as they were originally planned. Economy and efficiency have, of course, entered into all of the experiments. If a water supply, for example, required a laborer's full time to clean out a time-honored V-trough, a more sanitary one was devised and the laborer's wage capitalized to put it in. Moreover, such structural problems as the best type of, and material for, feeding troughs and sleeping floors needed careful attention, for a poorly fed or uncomfortable hog puts on fat slowly. These details are mentioned here and in the article to impress upon municipal officials and engineers that hog feeding is no less a scientific technical problem than is the operation of a reduction plant or a sewage disposal works. The hogs are just as hard to handle and require just as much care and scientific treatment as a bacteria bed. In Denver there seems to be money in the business, too. The sanitary end in a more humid climate may not be so simple as in the arid regions of the West, a point that should be carefully considered by Eastern men who may be attracted to the possibilities of the hog method of disposing of garbage.

A Shock-Absorber

"AMERICAN industry is being equipped with a shock-absorber." This expression, introducing the leading article in this issue, describes graphically the big idea back of the industrial survey being made under the auspices of the Naval Consulting Board. The military side of the work—adequate preparedness for a conflict—has been widely advertised, but Mr. Tomlin's article, this journal believes, is the first clear-cut expression of the industrial side of the problem. The majority of Americans have applauded the military purpose of the census. They have seen how England and Russia courted defeat through their lack of industrial preparedness, and that it took fully a year and a half after the declaration of war before these countries had the manufacturing side of their warfare on a satisfactory basis. Our citizens, though, have given little thought to what would happen, on the declaration of war, to the man with a factory. Would he be obliged to close his doors over night because of the collapse of the market and the enlistment of his men? Could he, in the face of powerful competition, get war orders or men to execute them should he get the contracts? These questions are to be solved in advance, and if that terrible contingency, war, ever comes, the industries of the country are to slip quietly from ways of peace to those of war. Not least among the important features of the plan is the creation of an industrial reserve force so that the men whose greatest value to the country is at the lathe, and not in the trench, will be kept from the firing line. England had to learn at bitter cost the folly of letting skilled mechanics and foremen enlist. Thanks to the work of Mr. Coffin and his organization we may expect to avoid that disaster. The work, organized and carried out by engineers, is one in which the engineering profession should be especially interested. The Engineering Record takes great pleasure, therefore, in presenting an authoritative account of what is being done.

The Nation's Business

THE TITLE used for this note, "The Nation's Business," is that employed for the journal of the Chambers of Commerce of the United States. It aptly describes the activities of this organization, which, while comparatively young, has already made a strong impress upon the business life of the country. The chamber and the journal afford a forum where the business men of the nation can express themselves on large public problems. The latest number of the journal, for example, discusses the resolution proposed by the chamber, and introduced in the Senate by Senator Newlands, which would direct the Interstate Commerce Commission to make an inquiry into the wage controversy pending between the railroads and their employees, and also gives the results of a vote on the question of universal military training. The vote on this question, by the way, was overwhelmingly in favor of such training. These activities of the business men of the country promise well for future legislation. While the views expressed cannot alone be governing, they should have great weight with the members of Congress. At least, the Senate and the House of Representatives will have no doubt where the business interests of the country stand on important questions.

Civil Engineering After the War

AS NOTED in these pages July 15, the European Allied Powers are carefully studying the problem of economic recuperation. They are, however, not alone concerned with export-trade conditions. They realize that internal readjustment is just as important. In fact, internal disarrangement, if it exist, is sure to render abortive much of the Allied co-operation that has been planned.

An editorial in our esteemed British contemporary, *Engineering*, is indicative of the careful consideration which is being given all phases of the expected industrial situation. It points out that preparations must be made well in advance for the reception of the skilled and unskilled workers coming back from the front. There will be available a large army of men accustomed to open-air life, full of the virility "engendered by the simple and strenuous life of the trenches and eager for physical work of a remunerative character." Civil engineering works, it rightly contends, should afford the openings which the returning veterans will seek. It, therefore, urges that broad schemes be now planned and taken in hand even before hostilities cease in order that the places may be open when the army returns. It especially urges that comprehensive railroad and highway schemes be set on foot. In many of the large cities, and in the neighborhood of London particularly, there is great need for new street-opening work and new rural highways to relieve congestion. If their construction is under way at the termination of the war not only will the workers be available but the immense fleets of motor trucks now in service at the front will be available for the necessary transportation work.

If it be objected that the financial situation does not permit such anticipatory measures *Engineering* replies that the "government must afford assistance on the principle that it is better to advance loans to municipal authorities and to public corporations for the prosecution of work of a profit-yielding character rather than to organize benevolent schemes for the help of men and their families who are unable at once to find employment."

While in this country we do not face identical post-bellum labor conditions, there is every reason for feeling that there will be a most acute labor situation here when Europe stops fighting. While it may be possible to prevent inroads of cheap imports from Europe it is not to be expected that we will be equally successful in maintaining our foreign trade. Could we maintain or increase that, we should have prospects of employing the labor released from munitions making. As it is we are almost certainly facing a labor surplus. That will mean that men now getting enormous wages must accept a reduction. Reduction will be taken with bad grace and industrial conflict must be expected.

It is apparent, therefore, that while conditions here are not identical with those in England there is just as great need for a careful consideration of the disposal of our labor after the war as there is of that abroad. We should have one great advantage over England in that money will likely be plentiful here. That should stimulate domestic activities, and in a domestic revival, since we cannot hope that our foreign trade will save us, lies the only prospect of relief. But relief even from that source could be only partial. The readjustment of the wage scale would still give trouble. The country, however, would be the gainer by whatever extent we were able without disturbance to transfer our energies to the activities of peace.

Practical Significance of Yield Point in Steel

IN AN EDITORIAL on the elastic limit of steel in the last issue of the Engineering Record reference was made to the definition of yield point proposed by one of the committees of the American Society for Testing Materials. The term was defined as "the load per unit of original area at which a marked increase in the deformation of the specimen occurs without increase of load." In a recent discussion of the relation between yield point and proportional limit of steel, abstracted in the Engineering Record of July 15, page 78, to which allusion was also made in the before-mentioned editorial, a prominent testing engineer asserted that the term yield point is essentially "vague and uncertain," and that "the most that can be said about it is that a structural member loaded up to its yield point will suffer a certain amount of permanent strain." If that is in reality the only physical significance that attaches to yield point, it may pertinently be asked why it should continue to be, as it has long been, the only requirement relative to elastic strength in nearly all specifications for structural steel.

Amid the bewildering discussion of "what we don't know about the elastic limit," directed essentially to its strictly scientific aspects, with which the engineering profession has recently been regaled, it may be profitable to consider briefly, by way of practical orientation, what engineers do know about the yield point.

Aside from the ease with which the tensile yield point can be determined in commercial testing, for materials possessing a true yield point, it may be rightly claimed that there is no physical constant which furnishes a more reliable criterion of what may be called, in a practical sense, the extreme life limit of structural steel, both in tension and compression, when used for structural purposes.

Thus, while a tension member "will suffer a certain amount of permanent strain" under stress even far below the yield point, the strain or deformation that a member of average length will exhibit at or slightly above the yield point becomes one of inches, so that the practical usefulness of the member is at an end, even though its stretch should not prove the indirect cause of the immediate failure of the structure. Obviously, this consideration does not apply to tension members, such as chains, used as separate units, which are commonly subjected to proof loads above the yield point for the detection of defective welds, and to improve their elastic behavior. In such instances the permanent initial elongation of the member may not only be unobjectionable, but beneficial, insuring increased rigidity under service conditions.

Again, for steel compression members the yield point in tension is approximately equal to the maximum unit stress that such members are capable of developing momentarily before failure, though only under the most favorable circumstances. These circumstances are that their slenderness ratio must not exceed the limit beyond which this factor will influence their ultimate strength, and that they must be so well designed that premature failure through faulty details will not occur.

The essential identity of yield point in tension and ultimate strength in compression, though long evidenced by tests of columns of carbon steel of relatively small cross-section, was strikingly confirmed in the recent report of tests of columns with relatively large sectional areas made under the direction of the Bureau of Standards. In these tests, reported in this journal July 1, which embraced columns of high-carbon steel and various alloy steels, the ultimate strength of the columns which failed as integral units differed by only one-half per cent from the average yield point of the material in tension. Moreover, the individual results fell invariably within the observed range of the yield point.

While our knowledge of the practical significance of the remarkable physical change which occurs at the yield point is concededly imperfect, there can be no doubt that its observance in commercial testing is abundantly justified, irrespective of any future trend toward greater refinements in testing.

The Failure of Government Railway Ownership in Canada

ENGINEERS on this side of the Dominion boundary are acquainted in a general way with the sad experiences that Canada has had with the public financing of railways. The case of the National Transcontinental, which so greatly exceeded its estimated cost of construction that the Grand Trunk refused to carry out its agreement to lease the line, is still fresh in mind. Much less is probably known by our engineers regarding the lines which the Dominion has long owned and operated. In the June number of the *Journal of Political Economy* Samuel O. Dunn, editor of the *Railway Age Gazette*, presents a study of the finances of these lines under the title, "The Failure of Government Ownership in Canada." In his usual lucid and convincing style, he analyzes and weighs the figures, not drawing his conclusions until he has examined the subject from every angle so that all modifying factors are given proper consideration. His study is particularly interesting just now because the congressional resolution directing an inquiry into our railroad situation requires a report on the merits and disadvantages of government ownership. And Canadian conditions, be it remembered, are more like our own than are those of any other country.

There is one point fundamental in Mr. Dunn's argument. We have no doubt that all thinking men will readily concede it. He maintains that in order to learn what the government owned and operated railways of Canada have cost the people of the Dominion the deficits and interest thereon must be charged into the cost account, for evidently the investment represented and the losses incurred appear in the government debt and the interest paid on it. If the earnings of the railways had sufficed to pay their expenses and interest, the government debt and the interest charges would be proportionately smaller.

A second point of great importance is that in any comparison of privately owned with government-owned railways it should be remembered that the privately owned lines pay taxes, while publicly owned lines pay none. In other words, a government-owned line to be equally successful, compared with a privately owned line, should earn more than the latter by the amount of taxes it would have to pay if not owned by the state.

The railways owned and operated by the Dominion are the Intercolonial, the Prince Edward Island and the National Transcontinental, having a total length of 3803 miles. The Intercolonial has been owned for 47 years, the Prince Edward Island for 43 years, while the National Transcontinental has only recently been built. The last named is eliminated from Mr. Dunn's study, since the experience with it, from the operating side, has been so brief. Moreover, of the remaining roads the Intercolonial is the more important. It has 1457 miles of line, while the Prince Edward Island has 279 miles. The latter, further, is a narrow-gage line serving a restricted territory and may not be representative. For that reason the comparisons with privately owned lines in Canada and the United States are based on the Intercolonial's showing.

Official reports of the Intercolonial and the Prince Edward Island railways show the cost of the lines to be $112,351,000, or $64,718 per mile. Mr. Dunn maintains, however, that their cost to the Canadian public has actually been $381,000,000, or $219,000 per mile. This figure has been obtained by charging as part of the cost the successive deficits and the interest thereon. This enormous unit cost exceeds the average capitalization of any railways in the world except those of Great Britain, despite the fact that the lines are almost entirely single-track railways, are not very well constructed, maintained or equipped. Assuming that the physical value of the roads is equal to their officially reported cost, the difference between their present value and the total amount they have cost the Canadian public is $268,000,000, or $134,378 per mile, and this, as Mr. Dunn aptly puts it, "represents the absolute loss they have inflicted on the taxpayers of Canada." And this estimate is really an under estimate, for it makes no allowance for the taxes the government would have collected from them if they had been privately owned. If the Intercolonial and Prince Edward Island were taxed at the same rate as the railways of the United States, their taxes would be $600,000 a year.

The total deficit during the entire operating history of the lines is $12,800,000. A striking commentary on these losses is offered by the Windsor branch (32 miles long) of the Intercolonial, which has been leased to operating companies since 1881 and since 1911 has been operated by the Canadian Pacific. In every year but one since 1881 the government has received net earnings from it.

Having set forth the end results of the operation of these lines, Mr. Dunn inquires as to the reasons for the deficits. His discussion of rates is entirely too intricate to be touched on here. Suffice it to say that while those of the Intercolonial are lower than the rates of privately owned lines in the same territory, there are competitive and other conditions which are largely controlling. The principal reflection on the management on account of the rates is that under private ownership the length of the Intercolonial would probably have long since been reduced by means of a cut-off so as to place it on a competing basis with other lines in the same territory.

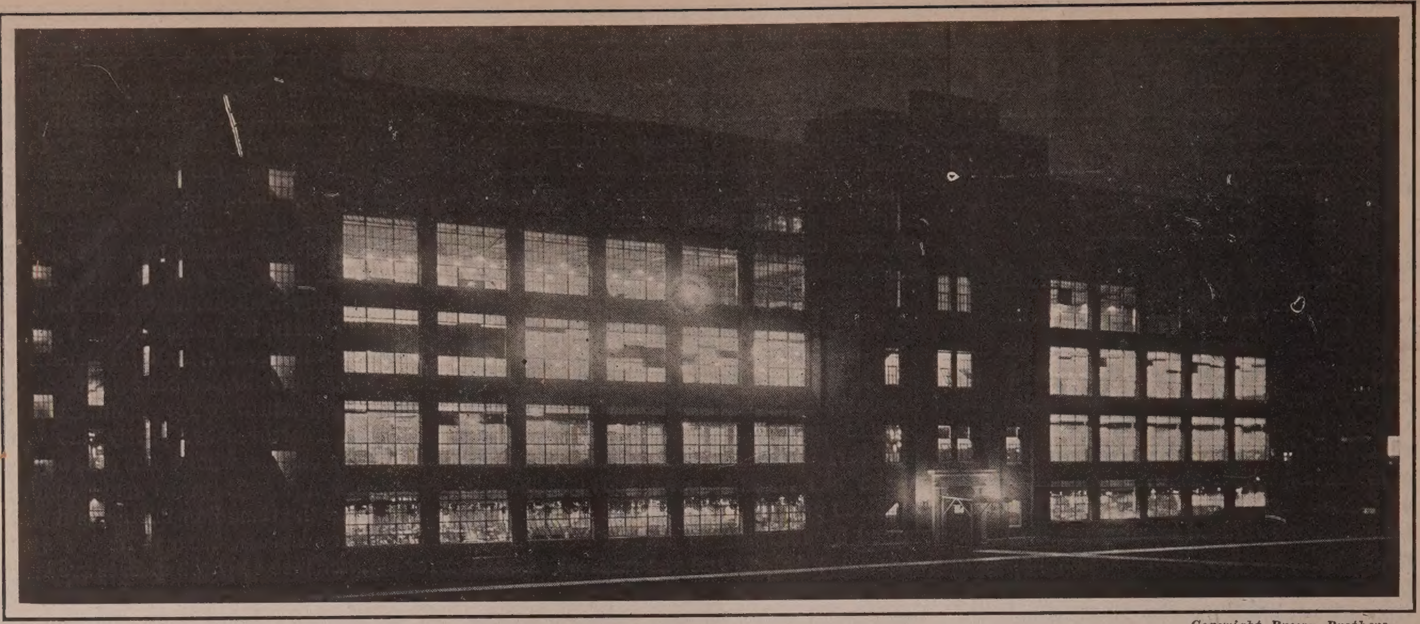
When the distribution of the operating revenues is studied, however, the reasons for the unfavorable showing of the Intercolonial become very apparent. The eastern lines of the Canadian Pacific operate through territory in every way similar to that served by the Intercolonial, and a comparison with it is therefore fair. While the Intercolonial spent 16.66 per cent of its total operating expenses for maintenance of way and structures, the Canadian Pacific eastern lines spent 21.87 per cent. On the other hand, though the Intercolonial's total traffic is only about 6.5 per cent heavier than that of the Canadian Pacific eastern lines, its cost of maintenance of equipment per mile is 11.5 per cent greater, its cost of conducting transportation per mile 13.5 per cent greater, its traffic expenses per mile 16.5 per cent greater, and its general expenses per mile 30 per cent greater. The smaller expenditures for maintenance of way and structures are partly due to the fact that, on the whole, its roadway and track are not kept in as good condition as those of the Canadian Pacific, and partly, Mr. Dunn suspects, because its low figures for maintenance of way expenses are largely fictitious, items that ordinarily are charged to maintenance going into the additions and betterments accounts.

And fundamentally, what is the cause of the Intercolonial's unfavorable showing? It comes back in the end to the politicians and the people. The officers in direct charge of the property have had little incentive to manage it well. The public and Parliament have not demanded this as the stockholders and directors of a railway company do. Consequently there has been a feeling of indifference regarding results on the part of officers. With reference to these lines the *Montreal Gazette* said on Oct. 21, 1915:

"Almost every abuse known to railroading took root and flourished, such as underbilling—that is, permitting a favored shipper to load the cars with a larger quantity of goods than he paid for, while his competitors on the other side of politics were restricted to a standard load and mulcted for any excess; the granting of secret rebates; the maintenance of an excessive number of stations and employees in order to swell the political influence of the road at election time; absurd classifications; unjust tariffs; the acquisition of more or less useless branch lines to serve partisan ends, and so on."

Mr. Dunn makes it clear that the present management is trying hard to eliminate the abuses and that it is not responsible for the conditions that have persisted in the past and that have resulted in the deficits above discussed.

Taken all in all Mr. Dunn's study is a most illuminating revelation regarding government railway operation under conditions substantially the same as our own. Canada's experience should give pause to those who look forward to a regime of government ownership and management in this country. Calm thinkers believe that we are surely drifting in that direction. Every sane man, however, will hope that long before that end is reached the public at large will have learned how difficult it is to expect efficiency from government management of large projects. With our shameless exhibition every year of a greedy scramble around the river-and-harbor and the public-buildings pork barrels, we have not even reason for turning to Canada to find out what will happen if the railways of the United States are thrown into the political arena.



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"SKILLED MECHANICS MUST BE KEPT FROM ENLISTING IN THE ARMY AND RETAINED IN THE MUNITION PLANTS"

Industrial Inventory by Engineers Will Stabilize Nation's Business in Crisis, Says Howard E. Coffin

Chairman of the Naval Consulting Board's Committee of Civilian Engineers, in Engineering Record Interview, Explains Method of Collecting Data on 35,000 Manufacturing Plants as National-Defense Measure

By ROBERT K. TOMLIN, JR.

Managing Editor of the Engineering Record

AMERICAN INDUSTRY is being equipped with a shock-absorber. It is in the form of the country-wide inventory of manufacturing resources which members of the five national engineering societies—civil, mechanical, electrical, mining and chemical—headed by Howard E. Coffin, chairman of the Naval Consulting Board's committee on industrial preparedness, are completing not merely as a measure of national defense but as a stabilizer of the nation's business in the event of a crisis. Primarily, of course, the object of the work, as explained to me by Mr. Coffin last week, is to insure for the Army and Navy an adequate supply of munitions and the countless other manufactured products which would be needed in the event of a war. This is the popular conception of the committee's task. But in providing in advance for these war-time demands the consummation of the committee's plans will insure the continuous employment of labor under any conditions which may arise and relieve the economic structure of the United States from strains which the impact of impending hostilities would ordinarily create.

IN ITS ESSENCE the problem which the industrial-preparedness committee of engineers is solving resolves itself into a nation-wide readjustment of production for war-time conditions and a consequent reallocation of labor from one industry to another. It is a case of determining, prior to a declaration of hostilities, the character and volume of manufactured products needed in the United States for both military and civil consumption, of providing plant and equipment for their output, and of recruiting for a vast army of industrial reserves the men best qualified to carry out the program contemplated—men whose services would be far more valuable at the lathe than in the trenches. Thus the effect of the work will be to create a huge mold into which the nation's business may be poured at quick notice and allowed to cool, without cracking, instead of surging at white heat in the crucible of an industrial crisis. From the data on the organization and output of the country's manufacturing plants, now partly collected by the Naval Consulting Board's committee, the size and shape of this vast mold and the plan of filling it are being accurately determined.

Interwoven with the activities of the committee are important legislative provisions already enacted or now pending. They relate to such vital matters as the creation of a permanent Council of Executive Information, to which members with wide experience in the several branches of industry will be appointed; an analysis of manufacturing facilities; the conversion of plants for war-time production and the obligatory filling of government orders; the procuring of a supply of gages, dies, jigs and tools needed in the production of munitions; the construction of a federal nitrate plant; and the filling of small "educational orders" by manufacturers in time of peace. While the committee at present is, in name, an advisory arm of the Navy, three-quarters of its work has been with the War Department.

"Our inventory," said Mr. Coffin, "is being confined to manufacturing plants of all types which are doing a gross annual business of $100,000. Certain smaller organizations are on our list, but the $100,000 concern is, in general, the criterion by which the scope of our work is controlled. On this basis our canvass will include about 35,000 industrial establishments. As to organization, we are backed by the resources of the five national engineering societies, representing a membership of about 30,000 technically trained men, and the work is apportioned by states, each state having a board of five members, one from each of the five engineering societies. These men are responsible for getting results in their territory. They are doing this work, at large personal sacrifices, without remuneration of any sort and are calling upon the fellow-members of their several professions for such assistance as they need.

"Our first task was to determine what information was most needed by the Army and Navy, and we have devised a blank form of eight pages calling for data under eight general heads, as follows: (1) Business and administrative; (2) plant; (3) manufacture and production; (4) labor; (5) transportation; (6) possible future arrangements; (7) inventory of manufacturing and producing equipment; (8) field notes (to be supplied by the Naval Consulting Board's representative). There is also included with the blank form a supplemental sheet for special data not provided for under one of the eight headings."

Mr. Coffin drew one of the industrial blank forms from a drawer in his desk. Under the "Business and Administrative" heading it calls for such items as the character and scope of the organization, the names and addresses of its executive officers and the names of the directors and principal stockholders. There are questions, also, concerning the physical value of the plant and the banks at which its business is done. The committee is evidently attaching great importance to the nationality of the plant personnel, for the questions "American citizen?" and "If not American citizen, country of birth?" appear several times in the inventory, referring both to the executive officers and to the employees in the lower grades.

Under the second item of the inventory,

"Plant," the questions relate to location, number and size of buildings, fire-protection system, power and water-supply service, capacity, housing of employees, facilities for plant enlargement, telegraphic and telephonic communication, etc.

Details regarding materials used and products manufactured are called for under the third classification. Inquiry is made regarding the normal slack season each year and the general system of marketing the product. An important question in this section is "Has plant facilities for construction of jigs and tools?"

In its queries regarding labor the blank form inquires as to the general labor conditions and the history of the plant's experiences with the union. There are also questions relating to the percentage of skilled and unskilled workers and the possibility of replacing men with women in certain departments. Information as to the possibility of night work is called for, and there is a query pertaining to the nationality percentages of the employees.

The fifth subdivision of the blank form deals exclusively with data on transportation facilities.

EDUCATIONAL ORDERS

Under the heading "Possible Future Arrangements" questions are asked regarding the plant owner's willingness to bid on government contracts and to accept what the committee terms a "minimum annual educational order." This feature Mr. Coffin emphasized as one of the most important elements of the committee's work. "In any large manufacturing plant," he explained, "it takes about a year to change models. Take the case of an automobile factory, for instance. To equip it for manufacturing shrapnel shells would require not only an analysis of the machinery and a large supply of special gages, jigs and machine tools—and these take a long time to produce—but also the development of a skilled working force familiar with the detail of making the new product. Using the data from our industrial inventory we might decide, for example, that the plant of Jones & Smith, manufacturers of farm machinery, could be adapted to the production of 6-in. shells. We would then place with this concern an order for ten of these shells a year, payment to be made on the basis of actual cost of production plus a reasonable profit. All special gages, jigs, etc., would be supplied by the government or made up and held subject to government order. Jones & Smith would fill the educational order and, in so doing, train a few of their men in the duties of this special service."

Thus would be produced a nucleus, in actual plant and personnel, around which could be built up on short notice an organization for handling large orders under conditions of urgent need. The manufacturer agrees that the minimum annual educational order shall be put through his factory in regular course and in such manner that foremen and those holding positions of responsibility shall become familiar with the peculiarities incident to the manufacture of these goods. In the event of war the manufacturer would be expected to concentrate upon this same product, and it is essential, therefore, that his entire organization, including purchasing, manufacturing, inspection, shipping, engineering, cost-keeping and administrative departments, be made familiar with the work. Minimum orders are not of sufficient size to interfere with a manufacturer's regular production.

INDUSTRIAL RESERVE NEEDED

Closely associated with the minimum educational-order scheme is the organization of a great industrial force capable of supplying the material needs of the armies in the field. "England's colossal blunder at the outbreak of the war," said Mr. Coffin, "was to allow many of her skilled mechanics to go to the front. Some of her shops which could, with a slight readjustment, have been converted into munition-producing sources were almost entirely stripped of their labor force. France did not make this mistake in the same degree. She had a close record of her labor through her system of universal military service and soon had most of her skilled mechanics back in the shops. Getting down to a more recent case, we have the example of the mobilization of the National Guard of the United States which was begun a month or so ago. The munition and tool-making plants in New England, I have been informed, have lost many foremen, department heads and skilled workers who were members of the National Guard and were called out for field service. Thousands of these expert workers planned to enlist in case of a further call for volunteers. Here, as in England, the best men are sure to be the first to volunteer. We are embarking on the same suicidal policy that England followed. Its effect in the mobilization of only about 100,000 members of the militia for service on the Mexican border is, of course, not serious, but our present lack of system in segregating the men who should fight from those who should produce the materials of warfare would demoralize our manufacturing organization in the event of a call for even half a million men. Think of the absolute wreckage, industrially, in our manufacturing, transportation and communication systems should we call for three or four million men, as will be necessary in case of trouble with any first-class Power. Skilled mechanics in all lines of production must be kept from enlistment in the Army and must be retained in the factories, mills and mines for the production of munitions. They must be kept on the job also on the railways and in the telegraph and telephone services. It is essential, therefore, that the names of these skilled workmen be listed and that the men themselves be enrolled in the Industrial Reserve."

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HOWARD E. COFFIN
Chairman of Naval Consulting Board's Committee and Directing Genius of the Nation-Wide Industrial Census

It is proposed that a button or other distinguishing mark shall be supplied by the government in the event of war to skilled workmen enrolled in the Industrial Reserves. Such enrollment shall be considered to carry with it honors equal to enrollment in the fighting army.

The last two pages of the industrial-inventory blank forms are devoted to manufacturing and producing equipment—calling for a description of work for which the equipment is best fitted and a summary of the classes of tools and machinery available—and field notes embodying explanations of special details given by the Naval Consulting Board's local committee members.

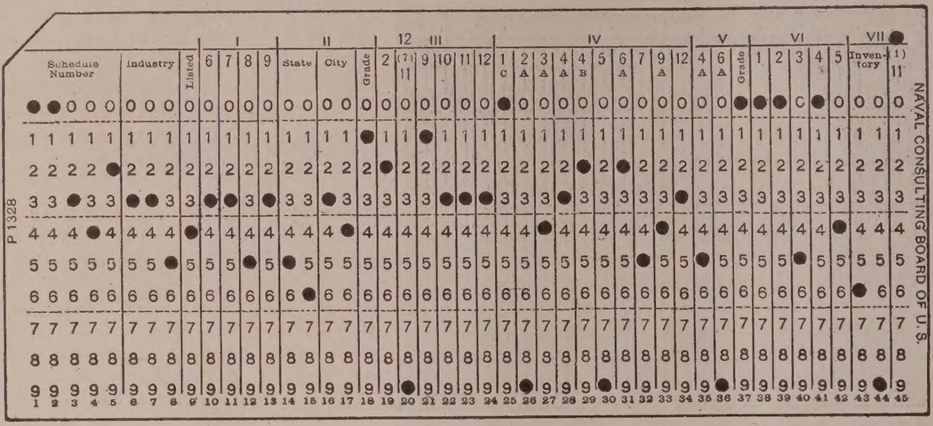
HOW INVENTORY IS MADE

Information for the industrial inventory is collected both by mail and by personal visits of local committee members to the plants. Each case is handled according to its own requirements. There is no standard form of procedure. The inventory forms, as soon as they have been properly filled out, are forwarded by the state heads of the survey to the main office in New York City. Then begins the work of analyzing the data, classifying them and reassembling them in a form best suited to the purposes they are intended to serve. In this work the civilian members of the committee are being assisted by a special board of officers consisting of Colonel Abiel L. Smith of the Quartermaster Corps, Major William E. Connor of the General Staff, Major Douglas MacArthur of the General Staff, Captain Richard H. Somers of the Ordnance Department and Captain Charles S. Wallace of the Signal Corps. These men are working in close co-operation with W. S. Gifford, whom Mr. Coffin has appointed supervising director of the survey. Captain Somers has direct charge of the work, in the office, pertaining to the analysis of inventory returns.

The information on the inventory forms is, obviously, of a strictly confidential character, and the first task of the headquarters office is to reduce it to code form. The work has been so completely systematized that all the information about a large manufacturing plant can be transferred to a card 7½ in. long and 3¼ in. wide, of which a sample is shown on this page. On this card are printed 45 columns of code numbers, the proper ones being punched by a special machine to convey information regarding a specific detail from the inventory blank. Thus a punched mark in the tenth column of the fifth line of printed numbers on the card might indicate that a certain foundry was well equipped to turn out tools and machinery for small arms and ammunition. A second punched mark might convey the information that 75 per cent of the employees were American citizens. A third hole in the card might mean that the transportation facilities at the works were not sufficient for handling a large output. The card, in reality, is the entire plant inventory in capsule form.

Cards Sorted Automatically

After Mr. Coffin had explained the scheme by which the inventory-form data were transferred by code punch marks to the small cards I asked him to describe the system by which the cards were filed so that detailed information could be available for quick reference. "The cards are not filed according to any system," he answered; "that is, no orderly arrangement or classification is followed except that all cards referring to one state are grouped together. Later we may still further classify by cities if found advantageous. That machine over in the corner is our automatic filing clerk. Suppose, for example, that we want to discover what plants in Michigan employ toolmakers. We merely set our automatic sorting machine to the code number corresponding to toolmakers and run the cards through the machine. Its mechanism picks out the cards we want and discards all others. One of these machines will sort cards at a rate of about 260 a minute. It's just like running a perforated music roll through a pianola."



THIS CARD, PROPERLY PUNCHED, CARRIES IN CODE FORM ALL THE INFORMATION ABOUT A LARGE MANUFACTURING PLANT

Of the 35,000 industrial plants scheduled for inventory, reports have already been received in the office from about 15,000. A great many more are still in the hands of the state boards. In view of the fact that the field work was started only June 1 this achievement is a great tribute to the efficiency of the nation-wide system for collecting the statistics and to the men who devised it and placed it in operation.

Surprises in Plant Output

The results of the census have brought to light some surprising facts concerning the adaptability of plants to the manufacture of products for which they were never intended. A jeweler of national reputation, whose products are popularly associated with weddings, has the equipment to produce bronze castings for high-speed submarine destroyers. A manufacturer of threshing machinery expressed the belief that he could make 600 6-in. shells per day. A foundry agreed to turn out tools and machinery for rifles and ammunition, and a maker of pocket knives volunteered to produce various lines of munition supplies. A maker of underwear saw an opportunity to use his plant for the manufacture of bandages and other Red Cross supplies, while a steel-spring manufacturer stands ready to supply bayonets and sabres. A crushed-stone company saw where it could play a large part in maintaining good roads against the wear and tear of modern military transportation, while a tailoring concern expressed a desire to make up uniforms. A gas-manufacturing plant finds that it can supply pure refined benzol and tuluol and can be extended to work up coke byproducts. A famous linotype company stated that it had a large quantity of lathes, drills, milling machines and other tools adapted for the production of shells, fuses, accurate machine tools and small metal parts requiring extreme precision.

Co-operation Imperative

The committee on industrial preparedness has been instrumental in demonstrating to manufacturers the desirability of hearty co-operation in the census work. There are, according to Mr. Coffin, four reasons which have combined to make the census a success. In the first place, all interests concerned in this work are actuated by patriotic motives. Secondly, manufacturers who can adapt their output to the needs of the Army and Navy are effectively insured against a shutdown in time of war. Thirdly, every large employer of skilled labor will know in advance what work he will be called upon to do and will therefore be able, in large measure, to hold his labor organization together. Last, but far from least, that manufacturing plant which cannot or will not put its equipment into the government service, either in the production of Army and Navy materials or supplies for the civilian population, must, of necessity, be stripped of its labor and tools for use in other fields. From the standpoint of labor the industrial census has a tremendous significance. It means that skilled men will be kept at work in the shops and will not be mustered into active service. "Sweat, not blood, must be labor's contribution to war," according to Mr. Coffin.

"The whole foreign struggle," Mr. Coffin concluded, "has been one of production. Germany was organized for it, and to this she owes the military successes she won early in the war. The Allied Powers were totally unprepared and are just beginning, now, to reach a condition of industrial efficiency. Our Army of the United States is exceedingly small. To make it effective we must back it up by organized industry. Our resources are great, but they must be organized on definite lines if they are to be of any real use in an emergency. A close-working organization of our industrial resources by the nation's engineers and manufacturers is what we need most today, and it is, in the end, the cheapest kind of preparedness."

Federal Road Allotments as Listed Incorrect

Apportionment Provided in Bill Reported in Issue of July 8 Correctly Tabulated with Percentage and Amount to Each State

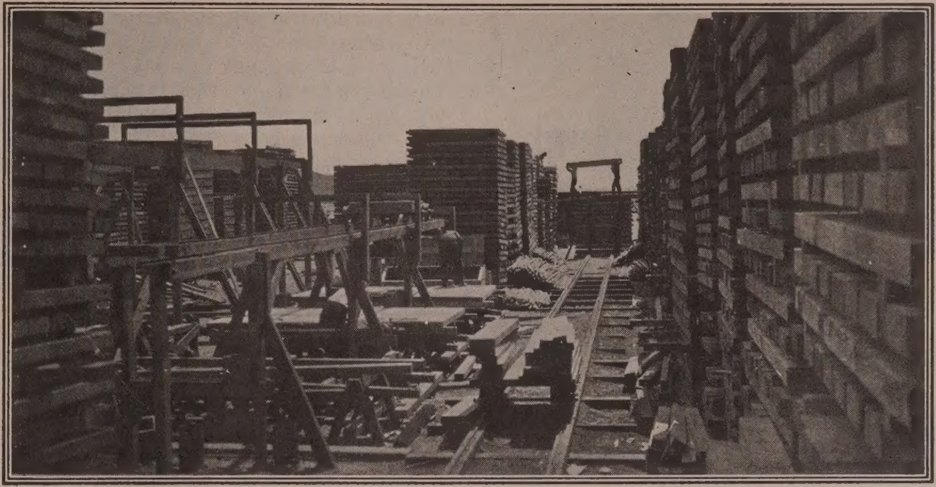
OWING to the use of a table conforming to the provisions of a previous bill, the allotment to the various states of the appropriation in the federal good-roads bill passed June 28 and signed by the President July 11, reported in the issue of July 8, page 42, was incorrect. The apportionment is to be made to each state according to area, population and mileage of rural delivery and star routes. The table herewith shows the per cent allotted to each state and the correct total amount for 1917, after deducting 3 per cent for administrative purposes. The amounts for each state for the succeeding years 1918, 1919, 1920 and 1921 will be respectively two, three, four and five times the amounts given in the last column of the accompanying table.

ALLOTMENT OF FEDERAL ROAD-BUILDING FUNDS TO STATES—1917

State	Per cent of apportionment	Amount of apportionment
Alabama	2.144	$104,000
Arizona	1.435	69,600
Arkansas	1.697	82,300
California	3.115	151,100
Colorado	1.736	84,200
Connecticut	0.638	30,950
Delaware	0.166	8,050
Florida	1.121	54,350
Georgia	2.773	134,500
Idaho	1.255	60,850
Illinois	4.576	221,950
Indiana	2.812	136,400
Iowa	3.014	146,200
Kansas	2.975	144,400
Kentucky	2.012	97,550
Louisiana	1.359	65,900
Maine	0.975	47,300
Maryland	0.883	42,800
Massachusetts	1.520	73,700
Michigan	3.013	146,150
Minnesota	2.921	141,700
Mississippi	1.828	88,650
Missouri	3.511	170,300
Montana	2.017	97,850
Nebraska	2.214	107,400
Nevada	1.339	64,950
New Hampshire	0.433	20,600
New Jersey	1.216	58,950
New Mexico	1.647	79,900
New York	5.170	250,750
North Carolina	2.328	112,900
North Dakota	1.568	76,150
Ohio	3.874	187,900
Oklahoma	2.365	114,700
Oregon	1.629	79,000
Pennsylvania	4.781	231,900
Rhode Island	0.241	11,700
South Carolina	1.482	71,950
South Dakota	1.675	81,250
Tennessee	2.365	114,700
Texas	6.021	292,000
Utah	1.159	56,200
Vermont	0.472	22,850
Virginia	2.040	98,950
Washington	1.465	71,050
West Virginia	1.101	53,400
Wisconsin	2.644	128,250
Wyoming	1.275	61,850
Total	100.000	$4,850,000

Plank Roadway Laid Across Shifting Desert Sands

Road Near Holtville, Cal., Built of Units Assembled in Yard and, When Placed, Surfaced with Oil and Sand



YARD WHERE UNITS ARE BUILT—THREE ASSEMBLY TABLES ON LEFT

BETWEEN the Imperial irrigation district and Yuma, Ariz., a distance of about 50 miles, the greater part of the country to be traversed by the state highway is an arid desert. About midway of this section a range of low sand hills crosses the route selected, forming a belt about 6½ miles wide, through which travel has been practically impossible on account of the character of the soil. These sand hills are from 20 to 200 ft. in height, and are composed of a very fine, uniform-grained sand, similar to that used in an hour-glass. This sand is so fine and dry that when a handful is picked up, and the hand turned over with the palm down, the sand cannot be grasped tightly enough to prevent nearly all of it escaping through the minute crevices in the closed fist. Under the action of the wind, it drifts like huge snow banks, the hills generally having a flat slope toward the direction from which the wind comes and a very steep slope on the opposite face. This steep slope is so unstable that by scooping with the hand a small hole in the bottom of the slope the entire face above will be affected.

WIND MOVES HILLS

The wind does not blow constantly from one direction, but the general movement of the hills is in a southeasterly direction, the average advance being apparently only a few feet per annum. Some of the smaller hills and drifts, however, will move a number of feet during a single windstorm, and on this account the location of a standard type of concrete pavement would be inadvisable because of the impracticability of successfully combating the movement of the sand.

Under plans prepared by the California Highway Commission, 6 miles of portable plank roadway are now being constructed through the worst sections of this desert. This roadway will be 8 ft. wide, with double-width turnouts every 1000 ft., where two cars can sidetrack to allow others to pass on the main line. The roadway is built of 4-in. planks, solidly spiked to three stringers underneath, and, in addition, three strips of steel, 1½ in. wide by ¼ in. thick, are placed on top of the spikes to prevent the latter working loose, and are bolted through at intervals of 2 ft. One-half-inch carriage bolts are cinched up tight by means of nuts and washers under the bottom of the stringers.

The individual units are 12 ft. in length, weighing about 1500 lb. each, and are rigidly joined together by bolts and iron straps to prevent displacement. The only work done on the foundation before placing the plank units was to level off the sand with fresnos and road machine. When the units are placed, each one is worked back and forth so that the stringers settle in depressions and the planks rest directly on the sand crowded up between. Shoulders will be scraped up level with the top of the roadway for a width of 4 or 5 ft. on each side, and the planks, together with the narrow strip of leveled surface on each side, will be coated with hot road oil and then covered with coarse sand or fine gravel, as is customary in the case of the standard concrete roads. The planks will have two coats of road oil and sand, which should effectively prevent slivering and wear of the wooden surface.

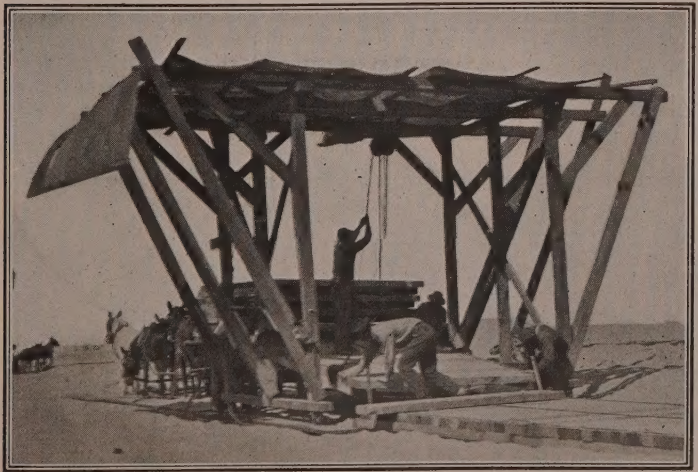
SHIFT ROAD TO AVOID DRIFTS

A small force of men and teams will be stationed in the vicinity of the plank road to clear away promptly small drifts as they occur, and to make, from time to time, such minor repairs as may be necessary. Whenever it is found that there is advancing across the road a sand hill of such size that it cannot successfully be removed, a short piece of the roadway will be taken up and shifted to one side to avoid the drift. A traveling crane has been built for use in laying plank units on the original location, and this will be available after completion to make such changes as experience shows to be necessary. One of the illustrations shows the crane in operation. After placing each unit it is moved along by hand on the plank runners provided for that purpose.

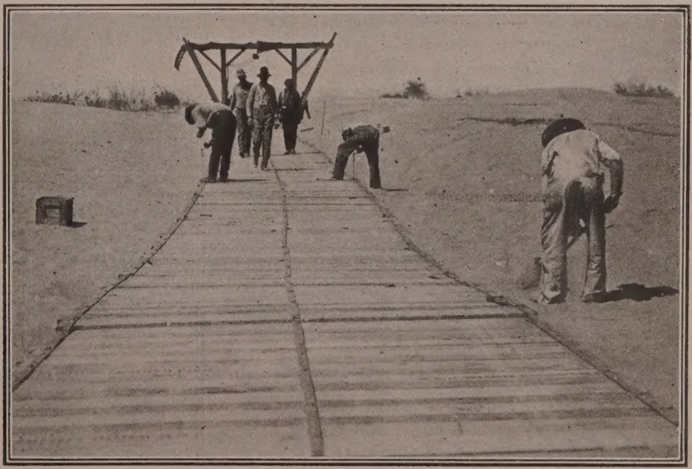
In ordinary locations, the life of a plank roadway of this type would probably be limited to four or five years, on account of rotting of the plank and timber sills; but on the desert, where the rainfall averages only 2 in. per annum, there is practically no moisture on the surface soil, and it is believed that the roadway, with proper care, will last at least 15 years.

CONSTRUCTION YARD EMPLOYED TO ASSEMBLE LUMBER

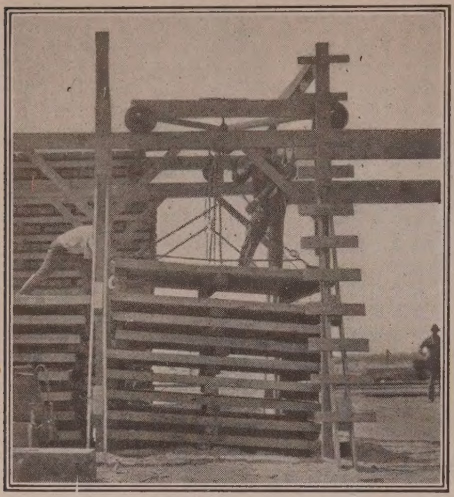
About 1,200,000 ft. of lumber was required for the 6 miles of roadway which is now being constructed, and to assemble this large amount of timber into units a construction yard was laid out, so that the work might be done with the greatest possible economy. At Ogilby, Cal., which is 4 miles from the nearest portion of the roadway to be constructed, but which is the nearest point where water could be had for the use of the men and teams, a fabricating plant was erected near the Southern Pacific Railroad. An overhead tramway was built to handle the lumber, and several hundred feet of trolley, with triplex chain blocks, were provided to pick up the completed units and transfer them from the three construction



OVERHEAD TRAMWAY DELIVERS TO PILE OR WAGON



CONNECTING THE UNITS UP TO FORM THE ROADWAY



GANTRY CRANE UNLOADING UNITS ON DESERT

tables, shown in one of the illustrations, to storage piles, and later to load them on the wagons for hauling to the work. Approximately 40,000 ½-in. holes, 8 in. deep, had to be bored, and for this purpose a small gas engine, operating from an overhead trolley, was provided at the yard and connected by a flexible shaft with hand drills. Ten-horse teams were used, which could haul nine units per load, including the capacity of the trailer, which was usually attached. The average haul was 7 miles.

A. B. Fletcher is chief engineer of the California Highway Commission. The work described in the foregoing was located in Division 7, of which W. W. Patch is division engineer and S. V. Cortelyou principal assistant.

Thirty-Seven Wells for Irrigation Project

Supplementary System in Tulare County, California, Is Planned to Supply 15,775 Acres of Citrus Lands

THE Lindsay-Strathmore irrigation district in Tulare County, California, has laid out an irrigation system planned to supply 15,775 acres of citrus lands. Of this total about 8000 acres, which are now producing crops, include some of the choicest orchard land in the state, valued at $2,000 per acre. The present water supply for the tract having become inadequate, it has been decided to sink wells in the delta of the Kaweah River, about ten miles north of the district, from which to procure a larger and cheaper supply.

The delta of the Kaweah River comprises an area of about 12,000 acres, which is believed to be an enormous subterranean reservoir, the material consisting of gravel and boulders. It is planned to sink 37 wells in this delta and to depend upon the underground storage accumulated during the period of maximum runoff, at which time the reservoir is filled to the point of saturation. It is expected to secure a total of 75 sec.-ft. from these wells and a seasonal delivery of about 26,000 acre-feet.

TURBINE PUMP FOR EACH WELL

Each well will be equipped with a direct-connected, motor-driven, deep-well turbine pump, operating under a total head of 100 ft. The water from all the wells will be delivered through a 60-in. reinforced concrete pipe a distance of 3½ miles to a ditch on the hills above the district. The ditch will have a length of 6¼ miles, will be lined with reinforced concrete and is to deliver 85 sec.-ft. on a grade of 1.92 ft. per mile. At the lower end of this ditch the water will be lifted by pumps to a high level ditch 160 ft. above.

This pumping plant will be equipped with three 16-in. horizontal, single-stage, centrifugal pumps direct connected to 500-hp. motors, and two 10-in. pumps of similar type driven by 200-hp. motors. The high level ditch will be built along the hills on the east side of the district and will have a total length of 5¼ miles. It will also be lined with reinforced concrete and is expected to deliver the same quantity as the ditch already mentioned, although its grade will be 5 ft. per mile. From its terminus the water will be delivered by gravity direct to the farmers. An additional booster station will be installed for raising water to the high level ditch No. 2, which is to supply the highest lands of the district. This station will be equipped with two 8-in. pumps arranged similarly to those in the larger stations, driven by 125-hp. motors. These will operate against a head of 160 ft. The system of mains and distributing pipes supplied by the ditches will range in size from 36 in. to 6 in. in diameter with a total length of about 95 miles. These pipes will be laid so as to deliver water under pressure at a designated point opposite every individual tract of land. All pipes up to 12 in. in diameter will be either of reinforced concrete or protected riveted steel. The latter type will be used exclusively for diameters exceeding 12 in.

The total cost of the work is estimated to be approximately $1,400,000. The entire plant is to be constructed during the present season; contracts are to be awarded, it is announced, about the latter part of June. C. W. Wright of Lindsay, Cal., is the secretary of the district, and Stephen E. Kieffer of San Francisco is the chief engineer.

Abandoned Bridge Difficult to Destroy

Heavy Charges of Dynamite Are Required to Demolish Reinforced-Concrete Structure Put Out of Service by Levee Extension Work

By J. H. WEATHERFORD
City Engineer, Memphis, Tenn.

IN connection with a levee system protecting certain low property in Memphis, Tenn., against floods of the Mississippi River, described in Engineering Record of June 10, page 775, a three-span concrete bridge 40 ft. wide and 120 ft. long, built in 1908, was abandoned and the old channel beneath filled up. This fill had its crown at a point about 10 ft. east of the concrete bridge and extended west along the bed of the old bayou to a junction with the levee fill described in that article. Fig. 1 shows the original levee, the concrete bridge destroyed, and a plate-girder railroad bridge also taken out. When the original levee fill was made, dirt which ordinarily would take a 1½ to 1 slope continually slid until it took the line indicated in the drawing as "top fill after slides," and it appeared to be necessary to quit on this fill until a later period, which was done.

BENTS UNDER RAILWAY BRIDGE

The two bents under the railway bridge each consisted of sixteen piles. The south one of these bents, which was almost directly in the channel, was shoved east and over half of the piles broken, so that it became necessary to cut them off and put in a temporary frame bent. The concrete bridge was carried on two abutments, extending well down into the bayou banks, and on two bents, each of four concrete columns 20 x 20 in. and 20 ft. long. These in turn were supported by a concrete sill 4 ft. square and 40 ft. long on wooden piles. These bents were apparently not disturbed by the original slide.

About 1912 it had been noted that the abutments were settling slightly and moving toward the center of the bayou, owing to the sliding of the banks. This settlement may be plainly seen on the north span in photograph 2. At the time the photograph was taken—May, 1916—the north abutment had sheared off under the end of the bridge and decided cracks had opened up north and south of the center columns, showing that these columns were carrying loads considerably greater than those for which they were designed.

HIGH WATER CHANGES PLANS

At the time the first settlement was noted it was determined to underpin the two abutments, so as to prevent further movement; but the high water of 1912 in the Mississippi River made it apparent that a protection levee and pumping station would have to be built and extensive work be done to protect the city against overflow. It was decided as a part of this work to abandon the bridge and fill the bayou under it. No attempt was made, therefore, to protect the abutments or stop the sliding.

The work of filling under the bridge was begun about May 1, and, in order to check the effect of the sliding from the west, the fill was first made east of the bridge with old concrete and brick, as shown in Fig. 1.

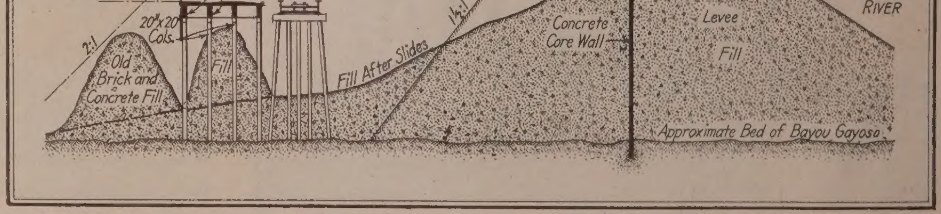
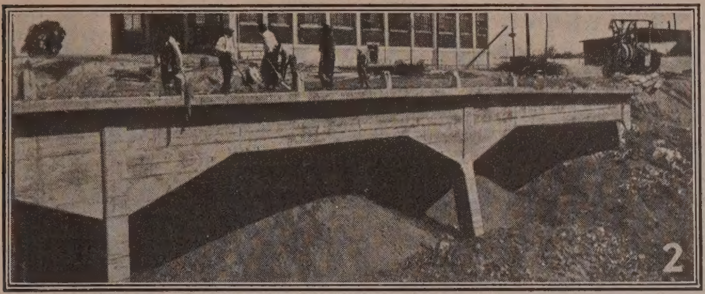
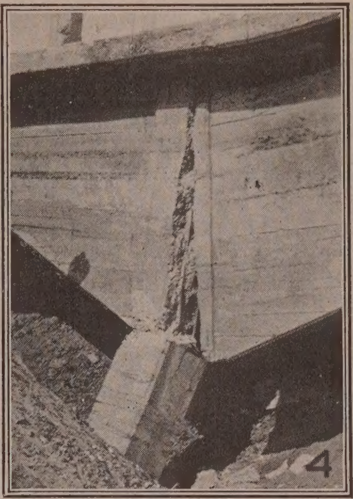
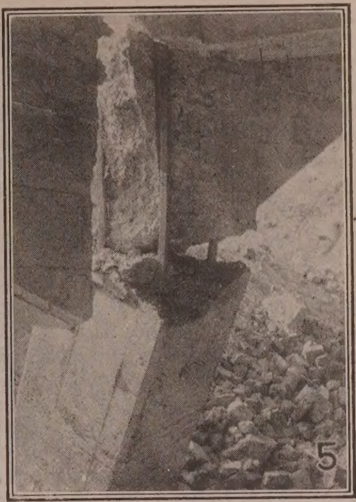
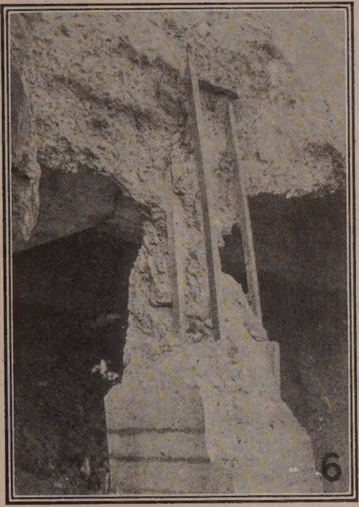


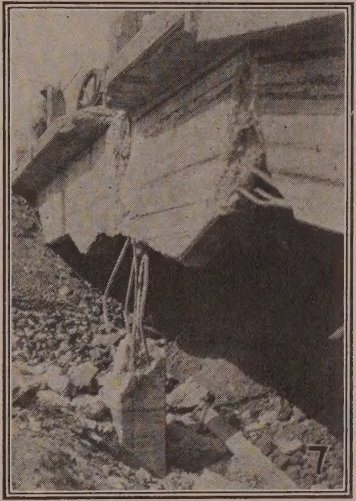
FIG. 1— FINAL FILL WILL ENGULF SITES OF BOTH CONCRETE BRIDGE AND RAILROAD STRUCTURE

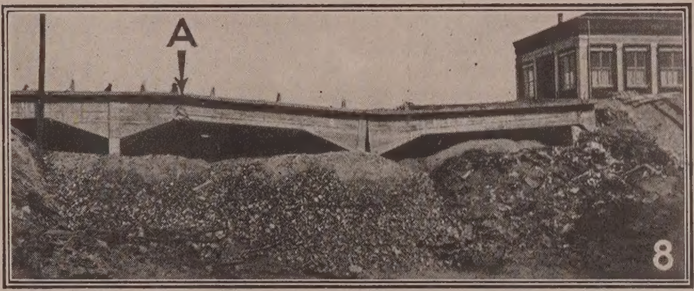


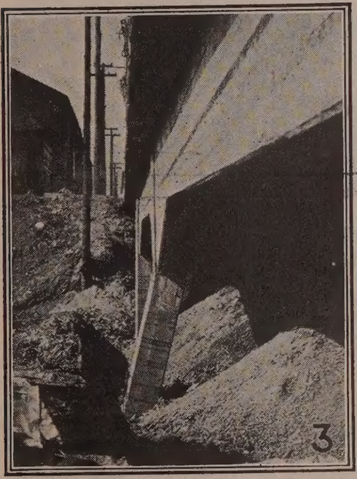






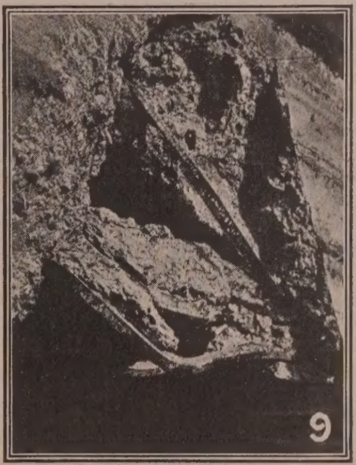


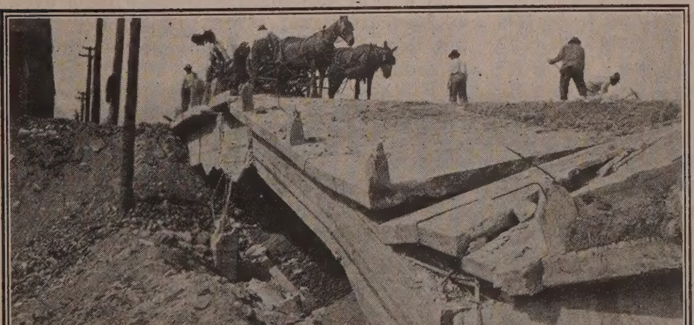


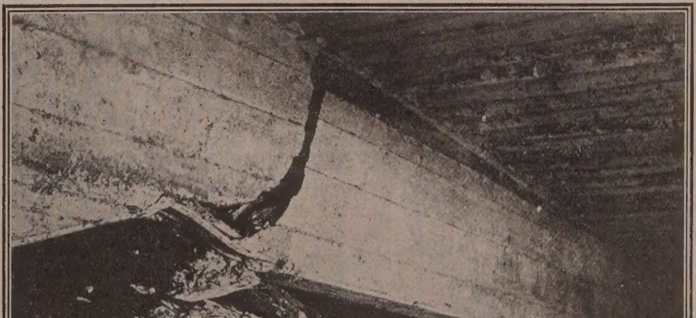


Concrete Bridge Stubbornly Resists Dynamite

1—ORIGINAL LEVEE FROM WHICH EARTH SLID DOWN TOWARD CONCRETE BRIDGE, CAUSING CRACKS IN COLUMNS
2—SLIDING OF FILL CAUSED SETTLEMENT OF NORTH SANDS
3—THE OUTSIDE COLUMNS EITHER SLID ON THE CONCRETE FILL OR BROKE NEAR THE BOTTOM, MOVING OUTWARD
4 AND 5—FURTHER MOVEMENT OCCURRED AS THE FILLING PROGRESSED
6—RESULT OF SHOCKS OF TEN STICKS OF DYNAMITE ON SOUTH COLUMNS OF EACH SIDE
7—EFFECT OF SECOND SHOCK ON SAME COLUMNS
8—CRUSHED POINT IN EAST GIRDER BETWEEN NORTH AND SOUTH COLUMNS
9—CLOSE VIEW OF BREAK AT "A" IN PHOTOGRAPH 8
10—AN EXAMPLE OF LACK OF LONGITUDINAL BARS IN BRIDGE FLOOR AND IMPERFECT BOND BETWEEN FLOOR AND BEAMS
11—INTERIOR BEAMS WHICH FAILED







Numerous holes were cut through the bridge and the work of filling under the bridge proceeded as rapidly as possible. In spite of the previous heavy fill made on the east, the dirt underneath shoved three columns of the north bent of the concrete bridge eastward and one column west. The interior columns apparently held at the bottom and crushed near the bottom of the bridge girder. The outside columns either slid on the concrete sill or broke at some point near the bottom and moved out as shown in the two photographs, 2 and 3. Further movement occurred as the filling progressed, as shown in photographs 4 and 5. As the condition of the bridge then appeared to be extremely dangerous, dynamite was resorted to and an endeavor made to break it down. Photograph 6 shows the result of a dobey shot of ten sticks of dynamite on the south column of the east side, and photograph 7 the effect of a second shot on the same column. Dynamite was then extensively used to complete the destruction, it being found necessary to put from four to ten shots against each girder before it would entirely collapse. The bars were slightly bent, but none was broken.

The column reinforcement is clearly shown in photograph 7. Vertical bars only were used, without hooping.

The most interesting feature developed is shown in photograph 5, in which it will be seen that the four smooth bars, although they were embedded fully 8 ft. in concrete above the point of the break, slipped without developing any apparent reduction in area. The twisted bar, however, which does not show in the photograph, pulled in two, thus showing that the full strength of the twisted steel was developed, but not the full strength of the smooth bars. It is to be noted, however, that the smooth bars had not been anchored at the top or the bottom as the best practice requires. While this photograph shows the concrete broken away around the bars above the break, this did not occur until they had pulled out of the concrete and continued sliding had broken the beam away from the column at that point. So far as a careful examination could determine, the break in the column was a clean break at the point shown in the photograph.

The concrete used in the bridge was proportioned six sacks of Portland cement to a cubic yard of Mississippi River sand and gravel, and the extreme difficulty in destroying the structure, as shown by the amount of dynamite necessary to demolish it, shows the wonderful tenacity and power of resistance of reinforced concrete.

Photograph 8 gives a view of the bridge corresponding to photographs 4 and 5, and shows a crushed point in the east girder between the south and north columns. Photograph 9 is a close view of this same point, which also shows in photograph 10. Photograph 10 also shows the lack of longitudinal bars in the bridge floor and imperfect bond between this floor and the beams. This, however, was developed largely by the dynamite. Photograph 11 is a view of one of the interior beams which failed at the same time that the outside beam failed.

After two of the columns in the south bent had been dynamited, and the north bent had entirely failed, an endeavor was made to crush the bridge by piling up a dirt load, but although approximately 6 ft. of dirt was spread over the entire structure, it did not even then fail until dynamite was extensively resorted to.

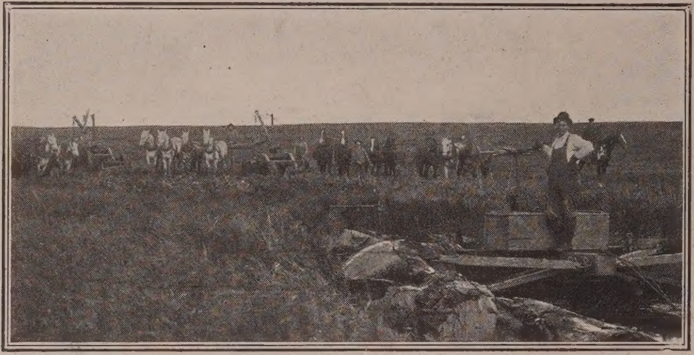
Gasoline Tractor Developed in Power Ditching

New Machine Hauls Itself and Equipment Over Soft Ground and Draws Plow Cutting Ditch of 21 Square Feet Cross-Section

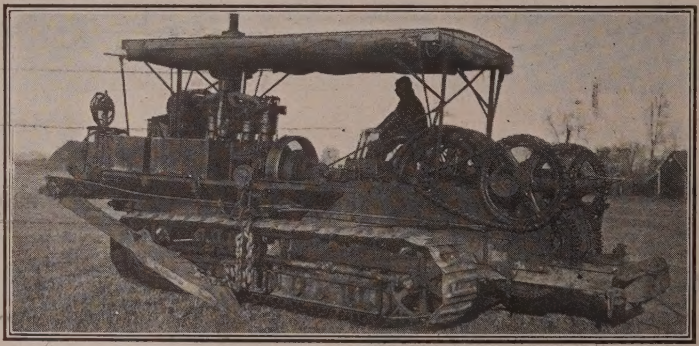
By FRANK C. PERKINS
Buffalo, N. Y.

THE LATEST development in cable-drawn plows for excavating drainage ditches of sizes too small to be economically handled by a dredge is the gasoline traction engine, mounted on caterpillars, shown in the photograph.

About 40 years ago a ditching plow was invented for such work and used in western Indiana. It had a double mold board and cut a ditch about 4 ft. wide on top, 2 ft. deep and with a bottom width of less than 1 ft. In making a ditch at one cut 80 oxen were used to draw the plow. The next step in the development of this type of ditching machine was the use of home-made wooden capstans and manila rope to draw the plow. Later wire rope, with better built capstans having self-anchoring devices, was introduced. Horses were used to haul these outfits and to turn the capstans. As more powerful equipment was developed, the plows were enlarged and built of steel. A standard outfit of this type consists of one plow drawn by two capstans using several thousand feet of steel cable. The plow cuts a ditch 8 ft. wide on top, 3 ft. deep and 18 in. in bottom width. It is equipped with wings on each side which push the earth back so as to leave a clear berm of 3 ft. Two ¾-in. steel cables, one to each capstan, are used. To the 14-in. vertical drum of each capstan is attached a 24-ft. sweep, to the end of which four horses are hitched abreast. The horses describe a circle almost 50 ft. in diameter to wind in 3 to 4 ft. of cable. Relays must be used, and ordinarily about 20 animals are necessary for each outfit. In ground free from stumps and rocks such an outfit can cut 100 rods or more of ditch per day. Frequently 50 miles of ditch in a season are cut at contract prices ranging from $1.25 to $2 per rod.



TEAM DITCHING OUTFIT AND 60-HORSE-POWER GASOLINE



TRACTOR THAT IS TAKING ITS PLACE ON DRAINAGE WORK

The gasoline machine which is replacing these outfits consists of an engine supported on two long caterpillars 30 in. wide, which carry a 16-in. diameter cable drum 24 in. long. This drum is driven from the main shaft of the 60-hp. engine and is geared to give a rope speed of 14 to 18 ft. per minute, depending on the amount of cable on the drum. About 1000 ft. of 1⅜-in. wire rope is used. When, on account of difficult ground or for other reasons, the tractor must be set at greater distance from the plow, removable lengths of 500 or 600 ft. of wire rope are attached between the plow and the end of the cable.

In operation, the plow, removed from its four wheel carriage, is left at the starting point of the ditch, the cable attached to its beam. The tractor moves ahead to the proper point on the line of the ditch, paying out the cable as it advances. The traction gear is then released and the drum thrown in. As soon as a strain is taken on the cable, two anchor flukes, visible in the photograph at the forward end of the machine, drop to the ground and bite in as the tractor moves backward until the latter is securely anchored. When the plow is drawn to the end of the cut, the drum is thrown out of gear and the traction thrown in. As the tractor advances, the anchors ride up from the ground and are hooked up in the clear by power.

One man and a helper are required to operate the tractor, while another man rides the plow. A team and driver are employed in hauling supplies, and a cabin on wheels, presided over by a cook, furnishes food for the crew. The plow, weighing 4 tons with its removable truck, a wagon loaded with cable and supplies and the cook wagon are hauled by the tractor over ordinary country roads at the rate of 2 miles per hour. Although the tractor weighs 15 tons, its large bearing surface enables it to travel over swamp lands too soft to support a team. A plow of increased size, which will cut ditches 2 ft. in bottom width and 3½ ft. deep, is used with the tractor.

It is said that the first tractor has proved so successful that several others are to be put in use during the summer by ditching contractors.

Highway Commission Exonerates Contractor in Part for Poor Workmanship

Contractors are not always entirely to blame for poor workmanship, in the opinion of Clinton Cowen, state highway commissioner of Ohio, as expressed in a paper presented at the last annual meeting of the Ohio Engineering Society. "His methods and manner of carrying on work," he added, "are based a great deal upon precedent. If he has been allowed by the engineer, on job after job, or year after year, to employ methods and carry on his work in a manner detrimental to the best construction, it must be expected that he will base his future work on such procedure, and I cannot see that he is to be censured for this so long as the engineers permit him to violate approved methods."

Five Thousand Hogs Eat Denver's Garbage

Successful Piggery Keynote of Solution of Garbage Disposal by Feeding Process—How Hogs Are Kept Immune

WHY the garbage-disposal problem in Denver has been solved with apparently so little friction has been a mystery to many an Eastern city official. Successful disposal by feeding to hogs has generally been considered a process restricted to comparatively small cities; nevertheless, the garbage of Denver, with its 225,000 people, has gone to a hog ranch for the last ten years, and the process is more of a success to-day than ever before. With these questions in mind, and many others, a representative of the Engineering Record made an inspection recently of the hog ranch to find, if possible, the "key." A successful hog ranch of enormous proportions, on which garbage is not the only diet, seemed to be the answer.

CONCRETE FEEDING SLAB ON LEFT AND FARROWING PENS AND SHED ON RIGHT

CITY PUT TO NO EXPENSE

Probably no other city of the size of Denver has such a contract as it has. There is no money consideration, but the city has no investment even for collection. The Denver Hog Ranch Company agrees to collect and dispose of the garbage in an efficient manner. Every day the downtown district is covered. Twice and three times a week the residential districts are served. This frequency is reduced during the coldest winter months. The company pays an inspector to handle complaints, but his authority comes from the city. Twice a day he gets records of complaints from the complaint clerk in the City Hall. He is furnished with a Ford truck, which enables him to carry two garbage cans. His business is to remedy the immediate condition, carry away a can, if necessary, and then adjust the matter so that the collector will do his work satisfactorily in the future. Perhaps a route is too large, or the collector is indifferent, for angels do not drive garbage wagons. The point is that there is a definite check, quickly applied. There are eighteen teams, fifteen of them serving the more congested districts, making two trips per day. The drivers are paid $40 per month plus board and bunks at the ranch.

Steel tanks holding 600 gal. are mounted on ordinary running gears. The rear end slopes up at an angle of 45 deg., and provision is made, if desirable, to dump the tanks by lifting the front end and rotating over the rear axle.

The horses and mules are kept in a barn at the ranch. The stable is of wooden construction, with haymow above. There are two rows of stalls facing a 12-ft. concrete passageway, down which an industrial track is laid for the distribution of feed. The comfort of the horse is conserved by letting him stand on a clay floor. Back of the stalls is a runway of concrete 6 ft. wide. Whether or not goats will prevent horses from getting sick, it is an old observation that they will. Nevertheless, since one has been allowed the privileges of the stable the horse mortality has been reduced to practically nothing.

PEN ARRANGEMENTS

In the plan of the hogpens, the various grades are separated for the purpose of feeding the balanced ration considered best, from experience, for the particular age and period of the hog's life. The farrowing shed, 504 ft. long, is a wooden structure 30 ft. wide, with 8 x 10-ft. pens on each side of a 10-ft. passageway. Connected with the inside pen is an outside 8 x 16-ft. feeding pen. These pens are all floored with 2-in. plank. As a harder floor makes the hog uneasy, the floors in all the pens where the animal sleeps are of wood. Garbage is fed direct from the tank wagons to the outside pens of this shed, as shown in one of the photographs, driveways being provided on both sides of the shed. On the opposite side of the driveways are 50 x 200-ft. fattening pens, where the feeding is done on concrete slabs. There is a fence on each side of this slab, with gates across the slab. Hogs being fattened will not entirely clean up garbage, so lean pigs and recently bred sows are let in to clean up the whole runway after the fatteners have finished. The sows are then driven out into a pasture. Each day the residue on these slabs is cleaned off into pick-up wagons, which deposit the material on a filling dump about ½ mile from the ranch. This is not a refined process of cleaning, shovels only being used. One other set of pens—those where the young pigs are weaned and then vaccinated—completes the different classes. They are 8 x 30 ft. outside, floored with concrete, and a 6 x 6-ft. shed floored with plank. When the young pigs are removed, the pens are cleaned out and sterilized with creolin.

CHOLERA CURE FOUND

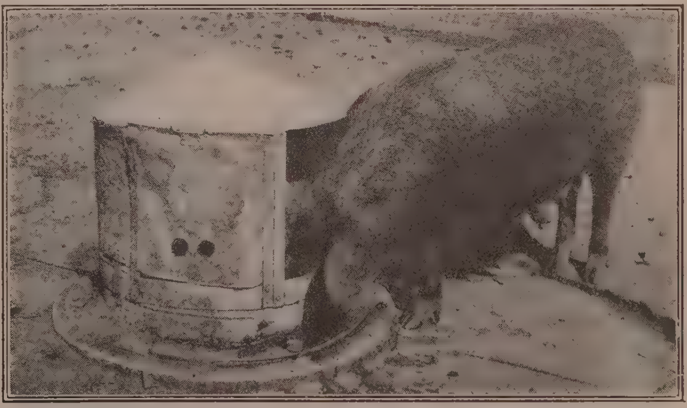
One of the principal things which make the system a success is that of keeping the hogs free of cholera. The whole herd of 5000 is immune, and a laboratory where serum and virus are prepared under the direction of skilled operators has been in operation six years. A new commercial serum plant, with twenty rooms in the laboratory and numerous outside pens for 500 hogs, was built this summer to afford a supply to hog growers throughout the country. This is a byproduct of the piggery, but it is one which made it a success financially. Cholera kills $50,000,000 worth of hogs per year in this country; the ranch company loses none, and sells guaranteed immune stock.

Another point is the balanced ration. Garbage alone will do, but a balanced ration is much preferred, as it makes better pork. Alfalfa is fed to excess in all the pens. Corn, swill, and finely cut alfalfa are used for fattening.

WATER SUPPLY

Water arrangements have been given much thought. Formerly a V-trough ran down the front of all the pens. This is still the system in the farrowing shed, but a

CONTINUOUS FEED BOX HAS SLOTTED ADJUSTMENT BOARD


WATERERS ARE SET IN CONCRETE—NOTE SLIDE FOR INSERTING LAMP

board is placed over the whole length, except for a space about 10 in. long, so that the animal can only get her nose into the trough, and thus not foul the stream or clog the trough. Outside, the troughs have been abandoned, as it required one man's time to keep the troughs clean, especially in winter. Two hundred Ideal hog waterers have been installed. These are patented, but the scheme was brought to perfection on this ranch. They consist of a circular galvanized hood with a small sector about 10 in. long indented for the water, which is controlled by a ballcock, to come up from below. In winter, a lamp is placed under the hood to prevent the pipes from freezing. Warm water keeps the hogs contented, and rushes the fattening process.

Do Not Sterilize Garbage

One of the things that could not be done was to sterilize the garbage. Several years ago there was much agitation against feeding raw garbage. The ranch company, therefore, spent $20,000 on a cooking outfit. The hogs did well on this ration for about sixty days, and then began to lose weight. Experts found organic acids were formed which at first stimulated the stomach, but finally irritated it. The plant consisted of a dumping platform, conveyors to tank cookers heated by steam from two 80-hp. boilers, and an elevated storage tank. As the cooked garbage was wet, a tank feeder was built with spouts on each side, through which the garbage could be discharged onto the feeding platforms. Mechanically everything worked out successfully, but the hogs could not stand the cooking.

Little Odor

As to odors, they were scarcely noticeable at the time of the inspection, in June, although the visit was made in the morning, before the pens had been cleaned for the day. However, it was explained that we were at a commercial hog ranch, not at a breakfast-food factory. Within five minutes after entering the grounds no odors at all were noticed. The drying effect of the atmosphere no doubt contributes greatly to this condition. The ranch is 5 miles from the business center of the city and about 2 miles from the outskirts. No complaints of a nuisance have ever been made.

One of the byproducts is the recovery of silverware for the hotels. Bones are put through a crusher driven by an 80-hp. engine. Approximately 21,600 tons of garbage are handled per year, and 150 tons of bone meal obtained. The Denver Hog Ranch Company gets about 60 per cent of the garbage, the remainder being cared for by private scavengers.

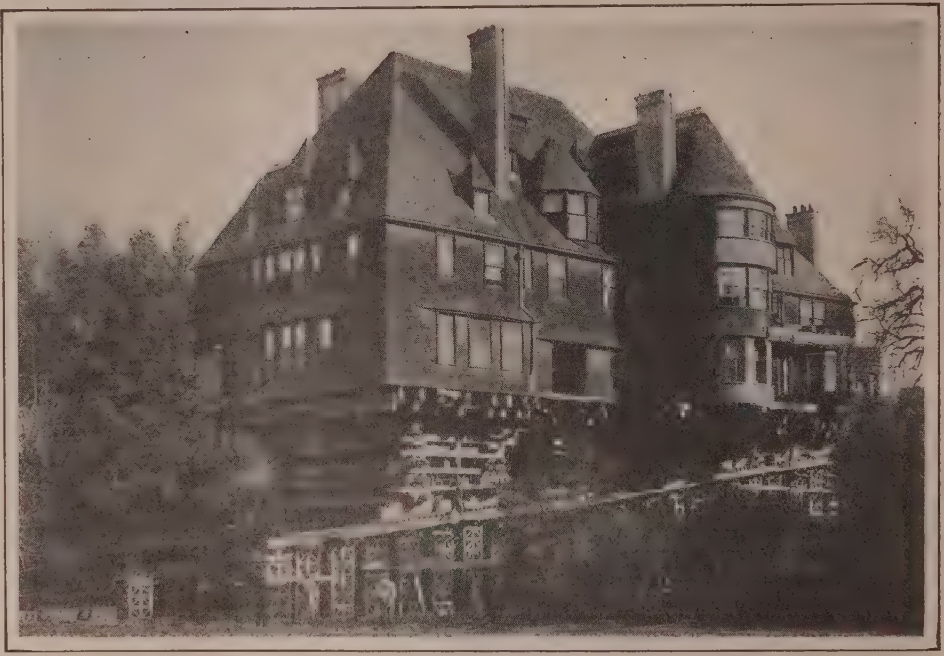
Plot Canal Cross-Section Notes in the Field

Cross-section plats of the finished canal sections on the 624 miles of canals in the Little River Drainage District of Missouri are made in the field directly from the observed readings, no other notes being taken. Thin cross-section paper is used and extra carbons are made, one for the chief engineer's file, one for the contractor and one for the resident engineer. William A. O'Brien, chief engineer, states that the method is simple, satisfactory, rapid and enables the engineer to check any unusual condition at once, whereas it might not be found if notes only were taken.

Long Move for 800-Ton Residence

Sharp Curves, Steep Grades and 40-Foot Trestlework Necessary in California House-Moving Job

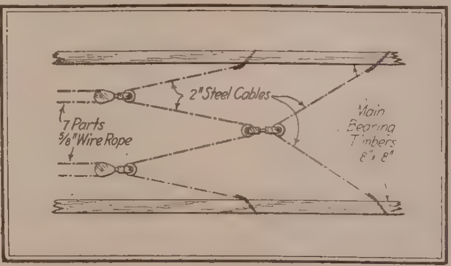
THE OLD Colonel Crocker residence in Hillsborough near San Francisco was recently purchased under the agreement that it would be removed by the buyer without injury to the trees of the estate. The house was built many years ago when massive construction was the custom. It is four stories high and 85 x 135 ft. in plan. There are about 33 rooms, several built-in safes and six large chimneys, one of which is estimated to weigh 45 tons. The total weight of the structure is roughly calculated to be about 800 tons.



800-TON HOUSE DESCENDS GRADE ACROSS GULLY ON 40-FOOT TRESTLE

It was found that the moving operations would necessitate a trestle 300 ft. long across a ravine and a 500-ft. grade down which the house must descend at the rate of 1½ in. per foot. The most difficult condition, however, was sharp curves required to avoid cutting trees. In one case a right-angle turn had to be made in about 400 ft. A runway of standard house-movers' cribs was built ahead of the structure as it advanced. The rollers ran on a bed of 12 x 14-in. stringers resting directly on the cribs and without post supports. Where the runway was highest the cribs were held in place with 12 x 12-in. braces placed every 20 ft.

In raising the structure from its old foundations five rows of 10 x 12-in. beams were placed lengthwise directly under the floor joists of the building. Then 12 x 14-in. crossbeams spaced 3 ft. apart were set directly under these longitudinal beams. Where chimneys or other extra-heavy loads were concentrated at one point the spacing of crossbeams was decreased or extra beams were provided. Seven were placed under the 45-ton chimney. Short 14 x 16-in. spring beams were laid beneath and parallel to the crossbeams, and rested in turn on two lines of 18 x 18-in. timbers running the full length of the building. Thus the load was finally centered on these two 18-in. beams, which bore directly on the 8-in. rollers and to which was applied the pull for moving the structure along the runway.



HITCH PREVENTED UNEQUAL PULL ON TIMBERS

The pull was supplied by two two-horse teams on capstans operating 7-sheave tackles rove with ⅝-in. wire rope. The tackles were attached to a 2-in. cable fastened to the 18-in. beams in such a way as to equalize the strain and prevent a greater pull coming on one tackle than on the other. The dead end of the hauling rig was secured by digging a 10-ft. trench 30 ft. long. The trench was bulkheaded with 8 x 10-in. timbers and in it were placed four upright 14 x 14-ft. posts 10 ft. long. Around these posts at the mid-point a 2-in. cable was wrapped and led thence to a convenient point for attaching the tackle. The building traveled usually at the rate of 20 ft. per hour, attended by a crew of 18 men.

Eight Circular Runways Beneath Shoring

Just before descending the steep grade it was necessary to swing the house through a half turn. This was done by building up eight circular runways beneath the shoring and providing each with rollers. A plumb line was hung at the center of the shoring, and each roller was pointed toward this so as to bring it to a true radial position. When this improvised turntable was ready the pull was applied at opposite corners in opposite directions, and by changing the direction of pull from time to time the half revolution was successfully completed.

The building was purchased from the Crocker estate by Charles J. Lindgren of Burlingame. Ellis Anderson, a Burlingame house-moving contractor, superintended the work.

Tests Show Activated-Sludge Process Adapted to Treatment of Stock-Yards Wastes

Sanitary Engineers of Armour & Company Report Results of Experiments Conducted at Union Stock Yards in Chicago

THE activated-sludge process of sewage treatment will satisfactorily purify the industrial wastes from the Packingtown factories of Armour & Company. The space required will be small and, if the sludge can be dewatered cheaply, the cost will be comparatively low. These, in short, are the conclusions arrived at by the officials of Armour & Company after an extended investigation by their sanitary engineers, M. D. Harding, assistant superintendent; G. L. Noble, engineer, and Paul Rudnick, chief chemist. From Mr. Harding the following information regarding the work has been obtained:

PACKINGHOUSE SEWAGE COMPLEX

This sewage is very concentrated and varies widely in its composition, as may be judged from the various manufacturing departments where it originates—beef slaughtering, sheep slaughtering, rendering, cold storage, stick plant, fertilizer works, degreasing plant, wool house, chemical laboratory, lard refinery, oleo plant, butterine factory, soda-fountain supplies factory, hog killing, pork curing, canned meats, power plant and the domestic sewage from 10,000 employees. According to the report on industrial wastes from the stock yards and Packingtown, made to the Board of Trustees of the Sanitary District of Chicago in October, 1914, the minimum analysis showed 58 parts per million of suspended solids and the maximum 2760.

Taking an average of all analyses made by the Sanitary District for each of the three Armour sewers and computing from records held by the mechanical department regarding the flow through each, the results show the average suspended parts per million for the day-and-night flow to be 700.

Analyses made by Armour & Company in recent investigations, however, show a slight reduction from this figure. This sewage, which originates from so many different sources and which contains so much solid material, is necessarily a difficult sewage to treat.

PRELIMINARY EXPERIMENTS

Armour & Company were the first packinghouse firm to experiment with concentrated industrial wastes, and there was some speculation as to whether the effect would be the same as that produced in more dilute domestic sewage. To determine this, sewage from the beef-slaughtering house was aërated in a tank 5 ft. long, 1 ft. wide and 12 ft. deep, with an open-air jet. In about twelve days the sludge took on a flaky appearance and settled fairly rapidly, although the clearer portion was still a yellowish color. The red color of the sewage was also changed to a brown. The vat was allowed to settle, the clear portion was drawn and fresh sewage was added every 12 hours. In this way, a clear, stable effluent was almost always obtained.

Occasionally it was difficult to get the desired result. Then it was decided to aërate a vat until a chemical analysis showed that the reduction of the complex nitrogen bodies was complete. Approximately 15 per cent of the volume of the tank was filled with previously aërated sludge containing about 99 per cent moisture and fresh sewage from the beef slaughtering was added to make up the remainder. The whole was then aërated with the following results:

AËRATION OF BEEF-SLAUGHTERING WASTES

Time	NITROGEN AS				Putrescibility
	Albuminoid Ammonia	Free Ammonia	Nitrites	Nitrates	
Fresh...	153.1	27.9	...	...	Positive
2 days.	129.0	34.0	0.5	...	Negative
4 days.	90.8	44.0	1.5	...	Negative
6 days.	55.9	69.8	6.4	...	Negative
9 days.	41.0	45.4	35.0	...	Negative
11 days.	9.3	26.4	44.0	0.7	Negative
16 days.	6.5	0.8	130.0	2.7	Negative
18 days.	2.8	...	0.1	9.8	Negative
19 days.	0.8	...	0.4	13.5	Negative
20 days.	0.8	0.6	0.3	16.0	Negative
21 days.	1.2	0.4	0.5	14.0	Negative

The foregoing analyses were all made according to the standard methods of the American Public Health Association. The first result was obtained by analyzing the entire sample. The other analyses were made on the clear portion after the sludge had settled out.

REPETITION BRINGS QUICKER RESULTS

Three facts stand out clearly in the table, according to Mr. Harding. First, oxidation was complete in 18 days; second, there was a loss of nitrogen in the effluent; and third, the methylene-blue test or the putrescibility, recommended by the American Public Health Association, gave a negative result after only two days' aëration, and long before the effluent was clear.

As soon as the composition became constant, the aërated sewage was allowed to settle for 45 min., the clear portion was drawn off, fresh sewage added and the mixture was again aërated until the process was complete. After repeating this a few times the period required to get the desired result was wonderfully shortened.

On adding fresh beef-slaughtering sewage to an equal amount of sludge containing about 99 per cent water a nonputrescible effluent was obtained after 2 hours' aëration, although the reduction of suspended solids was not as great as would have been obtained with a longer period of aëration.

A SMALL CONTINUOUS-FLOW PLANT

In the foregoing experiment the contained sludge would flake quickly and settle rapidly. These two facts—a quick settling sludge and a stable effluent—were enough in themselves to indicate great possibilities and to justify further research and experimentation. In other words, the bacteriological and chemical action involved was proved to be sound and unfailing, and the next step was to develop a continuous-flow plant so that the raw sewage, properly screened, would flow in at one point and a clear, stable effluent be continuously discharged at the other with suitable arrangements for disposing of the excess sludge accumulated.

The first continuous system used by Armour & Company for experimental purposes consisted of a box 4 x 3 ft. by 5 ft., built with horizontal, corrugated baffles in the aërating chamber and having the settling chamber in the same compartment, separated by a vertical baffle and built with a steep, sloping bottom so that the sludge would gravitate back to the bottom of the aërating tank. The idea was to give the sewage and air a longer flow by the use of corrugated baffles and at the same time trap some of the air in the corrugations, the supposition being that greater oxygen absorption would result. The air also gave a greater head to the water in the aërating side, causing it to flow into the settling chamber where the sludge was to settle and automatically return to the aërating tank and the clear portion overflow the edge. The results gained with this tank were not very satisfactory because it was so small that the flow of influent often clogged the small pipes.

The settling chamber was satisfactory from the standpoint of being undisturbed by the aëration. The sludge returned readily to the aërating chamber and a clear effluent was obtained. No data could be obtained as to air economy, but experiments on this point are now being conducted on a larger scale.

A 30,000-GALLON TANK

The necessity of a larger system was at once apparent, so the next step was to build a tank with a capacity of 30,000 gal. per day of 24 hours. It is this system, with additions made from time to time, that is in operation at present, and from which data are being collected that will enable the intelligent design of a plant large enough to purify the 5,000,000 gal. of sewage passing from the company's factories daily.

The data following are largely those obtained from operating the previously described system up to the present time. The plant consists primarily of five units: (1) Air pressure producing unit; (2) aërating tank; (3) settling chamber; (4) sludge storage; (5) sludge dewatering apparatus.

The air-producing unit at present consists of the air-compressing apparatus already in use in the power house. Whether a blower or a small compressor will be used eventually depends on the depth the aërating tank is built. If the aërating tank is built rather deep—say 20 or 25 ft., which, from data at present in hand, seems to be a desirable depth—then a compressor will be necessary. A blower would probably make the air cost more, considering the pressure necessary, and the load would be too great for a blower. The deeper tank will give a chance for greater absorption of oxygen from the air, which will help to offset the extra cost as the result of the extra pressure required. Of course, the depth of the tank will be determined by the space available, the nature of the footing, etc.

HOW SHOULD AIR BE DISTRIBUTED?

The tank in which the sewage is aërated is 10 x 20 ft. by 10 ft., and is divided by a central partition lengthwise of the tank, with an underflow at one end. The sewage thus enters at one end of the tank, flows the full length, returns on the other side of the partition and is discharged at the same end at which it enters. This is probably the style of tank which will be considered standard for this purpose, as it provides for few changes in the sewer lines.

Manufactured porous plates were first used for distributing the air, being placed in the trough of a sawtooth shaped false bottom, but they were of uneven porosity and gave a poor distribution. They were abandoned very soon and 1-in. galvanized iron pipe, perforated with 1/25-in. holes, 2 in. apart and staggered, were used instead. These pipes, Mr. Harding reports, give a very good distribution and have the advantage that they can be taken up and cleaned without shutting down the system. It is probable that a better method of distributing the air will be developed.

The sawtooth bottom in the aërating tank has also been abandoned as unnecessary. The specific gravity of the sludge is so nearly the same as that of water that the air keeps it thoroughly mixed with the sewage without the irregular bottom designed to bring any settling sludge back to the point of air discharge. This would probably not be true if the sewage were not well screened or passed through an effective grit chamber previously.

Underflow and overflow baffles are placed in the aërating tank about 6 ft. apart and are designed so that the sewage must take a zigzag course in addition to flowing up and down, thereby insuring a thorough mixing and preventing short-circuiting.

The settling chamber is built with a conical bottom so that the sludge will be concentrated at one point and easily siphoned off to the sludge storage. The settling period is about 40 min.

The sludge storage may be any shape tank where the sludge can be stored and aërated.

Dewatering Machinery

At present the dewatering machinery consists of small experimental machines, such as filter presses, centrifuges and driers. The company has not definitely decided what method of dewatering will be advisable.

The plant is now operating on the continuous-flow plan. It requires about 10 to 12 hours' aëration in the presence of 25 per cent of activated sludge to complete the action and make the continuous flow permanent. Then the sludge is further aërated for about 3 hours before being returned to the sewage chamber.

The amount of air used is 3 cu. ft. per gallon, or at the rate of 0.3 cu. ft. to a gallon per hour. The air is measured by means of an orifice and differential monometer and the water flow is gaged by a triangular weir.

The sludge resulting from this process has the following composition based on a 10-per cent moisture basis:

	Per Cent
Ammonia	5.57
Fat	5.54
Total phosphoric acid	2.05
Bone phosphate of lime	4.50
Water soluble potash	0.43

The value of the sludge as a fertilizer, therefore, depends upon its ammonia contents.

Much work has been done toward finding a practical method of dewatering the sludge. This material, not unlike activated sludge from domestic sewages, is light and flaky—having a specific gravity of about 1.02. The sludge which is siphoned from the settling chamber will average 99.5 per cent of water.

The first step in dewatering the sludge is further settling. The time of settling is naturally limited by two things—capacity and the fact that the sludge will become septic upon standing too long without air. It has been found that the sludge can be reduced from 99½ to 99 per cent moisture with from 4 to 6 hours' settling, provided it is in the proper condition. This reduces the volume which must be handled 50 per cent. In other words, the sludge becomes so much more concentrated that there is just half as much moisture to handle. Experiments have shown that settling under hydrostatic pressure takes place with more rapidity, but seems to have but little effect in the reduction of moisture. What other steps will be employed remains yet to be determined. Centrifuges appear to be a possibility in reducing the greater bulk of this moisture. By this means the moisture may be reduced to 92 per cent or 90 per cent. The solid bowl pipe has been found preferable.

A drier preceded, possibly, by the use of a Worthington type filter press may be the other two steps in reducing this sludge to a 10-per cent moisture basis. These remarks are of necessity only tentative, as they are based on the experimental work accomplished to date. It is possible a better method than any here suggested may later be found.

Cost of Treatment

At present it is very difficult to estimate what the cost of operation will be, as it is not known what the expense will be to dewater the sludge. Following is an estimate by Mr. Harding of the cost per 1,000,000 gal. as judged from the data available to date:

Air 3,000,000 cu. ft. at $0.003 per M	$9.00
Drying and preparing sludge for fertilizer (2 tons at $6)	12.00
Labor (considering capacity of 5,000,000 gal.)	2.00
Total	$23.00
Byproduct 2 tons fertilizer (5 units ammonia at $2)	20.00
Probable cost per 1,000,000 gal. exclusive of interest, depreciation and repairs	$3.00

The cost of air will vary depending on the price of electricity. Depreciation, repair and interest will probably remain fairly stationary. It is hoped that the sludge dewatering cost may be materially reduced.

A rectangular plant seems to be the most feasible plan of construction. Aërating chambers, settling chambers, and sludge storage tanks may all be included in the plan to advantage, as has been done in the experimental plants of several cities. The amount of space required will be about one-tenth to one-eighth of an acre per 1,000,000 gal., depending on the depth of the system.

The problems yet to be solved present themselves in about the following order of importance: (1) Dewatering of the sludge economically; (2) best method of distributing the air; (3) the relative length of time of aëration of sewage and sludge; (4) unfavorable influence of rapidly changing temperatures of the sewage.

230,450 Tons of Explosives for Industrial Purposes Produced in 1915

The production of explosives in the United States, excluding exports, during the calendar year 1915, according to figures that the U. S. Bureau of Mines has received from manufacturers, was 230,450 short tons, as compared with 225,126 short tons in 1914. The report covers only the explosives used in coal and metal mining, and other industrial enterprises.

Railway to Haul 225,000 Tons to Hetch Hetchy Dam

Comparing Auto Trucks and Steam Railway Results in Selecting the Latter for 60-Mile Haul

In planning the general construction scheme for the Hetch Hetchy dam, which is a feature of the new water-supply system being built for San Francisco, a comparative study was made of costs of handling construction materials by auto truck and by specially constructed steam railway. The distance from the nearest railroad to the dam site, following the general line of the aqueduct, is about 60 miles, and about 225,000 tons of construction materials will have to be hauled in. After a study of the conditions, M. M. O'Shaughnessy, city engineer of San Francisco, under whose direction the entire project is being carried out, reported that the immediate construction of a railroad from Rosasco to the dam site would mean a saving in freight bills to the city of about $1,000,000.

Improvements Estimated at $600,000

Surveys were made of both highway and railroad routes, and it was found that grading, bridges, culverts and surfacing on the 29-mile stretch of highway between Hetch Hetchy and Hamilton would total, including all costs, approximately $600,000. This stretch of road the city is obligated to build, under the terms of the Raker act, regardless of the method adopted for transporting materials. Detailed estimates on the construction of the 60-mile railroad as a whole showed the cost of the entire line to be $1,665,000. Thus, subtracting the cost of the 29-mile stretch, the outlay expressly for the railroad would be $1,065,000.

The cost of operation and maintenance of the railroad was figured at 7 cents per ton-mile, or $4.20 per ton for the 60-mile haul. At this rate the cost for 225,000 tons would be $954,000, and this, added to the $1,065,000, would make a total of $2,019,000, or 14.9 cents per ton-mile. This railroad is figured as a line with a maximum grade of 4 per cent, and after the construction period ends it is intended to remove the track and open the route to automobile traffic.

Cost of Hauling by Motor Truck

As to the cost of hauling by motor truck, a portion of Mr. O'Shaughnessy's report reads: "During part of the work on Contract No. 1 for building the road between Hog Ranch and Hetch Hetchy dam site motor trucks were used to haul the contractor's supplies from Chinese to Hog Ranch, a distance of 46 miles. The distance from Hog Ranch to Hetch Hetchy dam site by the new road is 9 miles, making the total distance from Chinese to Hetch Hetchy 55 miles. If motor trucks are required to work over the existing roads between Chinese and Hamilton there will be considerable expense incurred for maintaining those roads in a condition fit for such traffic. The grades are very heavy in many places. Under these conditions it is hardly possible to predict on any logical basis what the cost of hauling will be, but it is quite safe to say that it will not be less than 25 cents per ton-mile, or $13.75 per ton for the 55-mile haul. Cost of transporting 225,000 tons of material at this rate will be $3,095,000. It therefore appears that there is a balance in favor of the railroad haul amounting to $1,085,000."

Economical Precast Stairway Design Developed for Panama Canal Lighthouse

Stair String Treads and Radial Supporting Beams Were Made at a Central Plant, the Newel Post Only Being Cast in Place

By WALTER F. BEYER
Former Assistant Engineer, Isthmian Canal Commission

SPIRAL STAIRWAYS of reinforced concrete built by the unit method have been successfully and economically tried out in lighthouses on the Panama Canal. It is believed that when they were designed and built in 1911 no other similarly constructed stairways were in existence. A number of spiral stairways of the monolithic type have been built, but as far as is known the cost on account of the elaborate forms required has been excessive as compared with the unit method of construction. For example, one of the former type, about 30 ft. high, described in the Engineering Record of Nov. 6, 1915, page 574, was recently built in connection with a concrete bridge at Glens Falls, N. Y., at a cost slightly less than $4,000. This included a bronze handrail, the cost of which is not known. By the unit method of construction the actual cost in place of the stairways on the Canal Zone varied from $81.79 for a stairway 12 ft. high to $525.75 for one 60 ft. high. These costs are exclusive of a 1¼-in. iron-pipe handrail, the estimated cost of which for the 60-ft. stairway is $200, but inclusive of division cost, which would be about equal to a builder's profit.

STAIRWAYS BUILT OF PRECAST REINFORCED CONCRETE UNITS

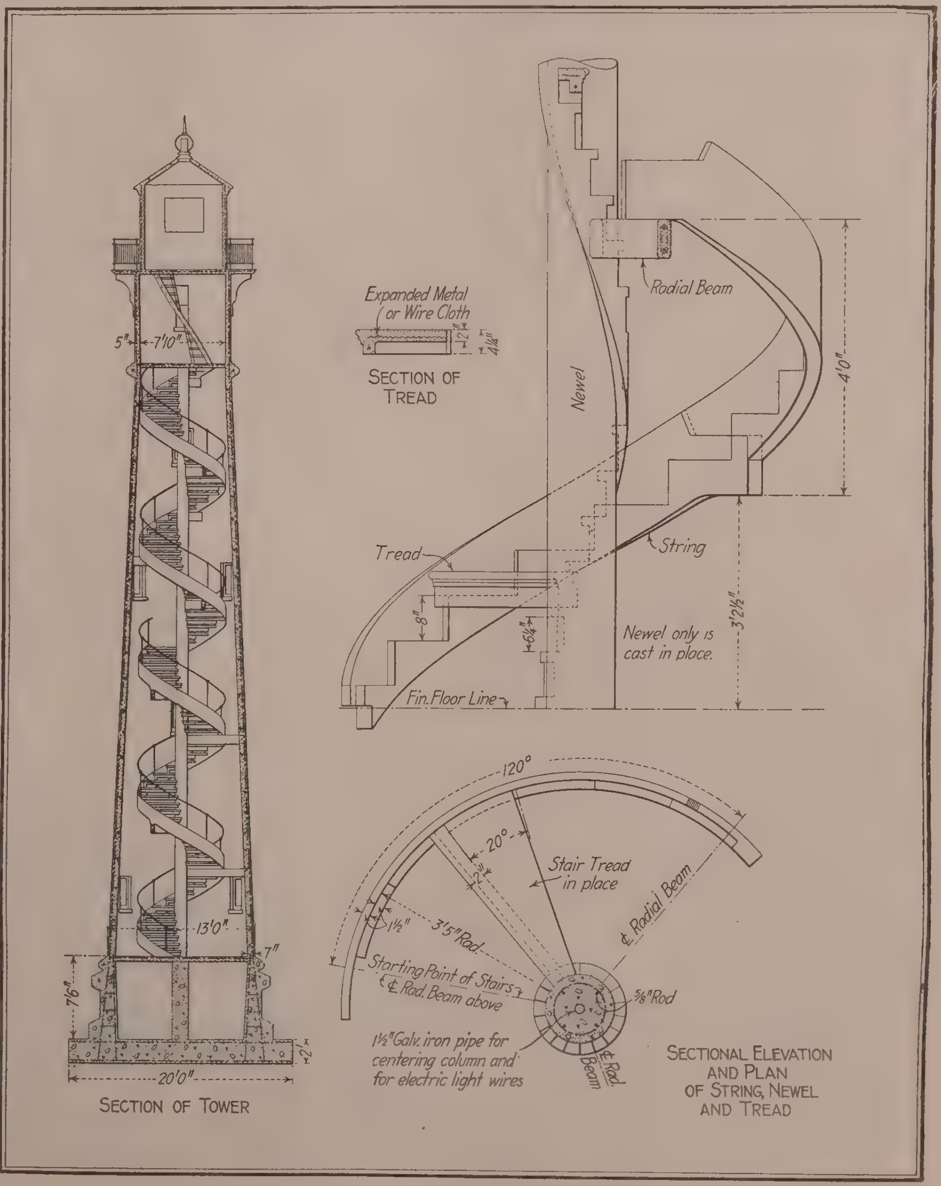
The stairways are built up of reinforced-concrete units precast at a central plant, and consist of stair string, treads and radial supporting beams, the newel post alone being cast in place as the tower was being constructed. The stair string, in the shape of a warped surface, was cast in 120-deg. sections about 9 ft. long, measured along the curve of the string, which is provided with rebates forming seats for the outer end of the stair treads. The inner end of the treads is supported by similar seats cast on the newel post. The string is 3 x 15 in. in cross-section and is reinforced with two ¾-in. rods, wrapped with No. 11 B. W. G. galvanized wire, having a 6-in. pitch. The upper and lower ends of the string are so shaped that one type of unit will serve for the starting unit, the terminating unit and the intermediate units. The heel of the starting unit is embedded in the concrete floor to prevent any slip, while the upper end rests on a support. In this case the support is a beam extending radially from the newel post to the tower wall.

The stair treads are cast in the shape of 20-deg. sectors, having a radius of 3 ft. 5¾ in., and are provided with nosing and apron. They are reinforced with a ⅝-in. rod placed in the lower part of the apron, and with woven-wire cloth laid about 1¼ in. from the top surface, extending to within 1 in. of the inner and outer edges of the tread. By using 20-deg. sectors an easy run is obtained, the average width of the tread being about 12 in. As will be seen from the drawing, the apron comes to within 1¾ in. of the top of the tread below it.

In the construction of the newel post a 2½-in. black iron pipe was used for the purpose of centering the column and for use as a conduit for electric-light wires leading to the lantern.

In erecting the stairway the matter of first importance is properly to orient the newel post and the starting unit of the stair string with respect to each other and to the final landing. As the newel post is cast in place it is oriented either by means of the slots provided for the radial beams or by the stair-tread seats. Similar slots are provided in the tower wall, their centers being 120 deg. apart horizontally and 4 ft. above one another vertically. In order to set the radial beams in place the wall slots are made about 2 in. deeper than is required, which permits the outer end of the beam first to be inserted into the wall and then, by sliding horizontally toward the center the inner end of the beam is inserted in the slot provided in the newel post. After the radial beams are in place and the mortar joints are sufficiently hard to carry the load, the starting unit of the stair string is set up, the heel is embedded in the floor and the upper end is rested on the first radial beam. Until the second unit is set in place it is necessary rigidly to shore the string so that it will maintain its proper position, which by virtue of its shape will, if not shored, have a tendency to lean out from the center. The second unit is then set up, its lower end resting in a mortar bed at the upper end of the starting unit. As soon as it is in place a shoulder of concrete between the outer face of the string and the wall is cast on top of the radial beam to keep the string permanently in place, thereby preventing any outward slip. The stair treads are then laid in mortar joints, preferably working from the top of the second stair-string unit down, in order to give the mortar sufficient time to set before being required to carry the weight of a man. The third, fourth, fifth and succeeding units of the stair string are similarly set up to convenient heights and the treads laid without the use of any scaffolding.

In high stairways an intermediate landing, as shown in the section of the tower, may be provided at any of the 4-ft. elevations by swinging the slots for the successive radial beams and the newel post stair seats as many degrees as are required for the platform.


5"
7'10"
13'0"
7"
7'6"
2'
20'0"
SECTION OF TOWER
Expanded Metal or Wire Cloth
2"
4¼"
SECTION OF TREAD
Newel
Radial Beam
4'0"
Tread
String
8"
6¼"
3'2½"
Newel only is cast in place.
Fin. Floor Line
120°
20°
2"
Stair Tread in place
℄ Radial Beam
1½"
3'5" Rad.
Starting Point of Stairs ℄ Rad. Beam above
⅝" Rod
1½" Galv. iron pipe for centering column and for electric light wires
℄ Rad. Beam
SECTIONAL ELEVATION AND PLAN OF STRING, NEWEL AND TREAD

SECTIONAL PLAN OF STRING, NEWEL AND ONE TREAD

PANAMA CANAL RANGE TOWERS HAVE UNIT-BUILT STAIRWAYS

A stairway thus built permits the use of treads and stringers of only one type in all conical towers, in spite of the fact that the higher towers have a greater diameter at the base than the lower ones. The only parts of those stairways which must vary in dimension to correspond to the batter of the tower are the radial beams, and they, too, are precast to the desired dimensions. Where towers are cylindrical, concrete lugs cast in the tower walls at their proper places may be used in place of the beam supports. If the height from floor to floor is not a multiple of four, the top stair-string unit may be cast to the desired length by using a cutoff in the forms.

The stairway in its simplest form presents a pleasing appearance, but this, however, may be enhanced by adding elaborate reinforced-concrete balustrades constructed by the unit method and mortared in place.

This type of construction also permits the use of a stairway of any desired diameter, for the cost of the forms is small, in many cases not more than $75.

Subsequent to the construction of the stairways described certain refinements in the design have been made by the writer, so that similar stairways can be built in the United States practically as cheaply as was done on the Panama Canal, where inferior colored labor was employed in the construction and where the cost of the forms was excessive.

Cement Production Decreases Slightly

An advance statement of final statistics of the Portland cement industry in 1915, compiled by E. F. Burchard of the U. S. Geological Survey, confirms the estimate, published Jan. 1, that there was a slight increase in shipments and a slight decrease in production and stocks as compared with 1914. The total shipments were 86,891,681 bbl., an increase of only 0.5 per cent over 1914, and the total production was 85,914,907 bbl., a decrease of 2.6 per cent. The average factory price, including all sections of the country, was $0.86 per barrel, as compared with $0.927 for 1914. Slight increases in the shipments and production in the Lehigh district are reported—24,598,950 bbl. and 24,876,442 bbl. respectively, representing 2.6 and 1.1 per cent increases over 1914. In New York State both shipments and production decreased—3.6 and 14.3 per cent respectively. Natural cement shipments decreased 442 bbl., but increased $7,257 in value compared with 1914.

Three-Hinged Arches and Curved Cantilever Roof Trusses Used in Recreation Building

Details of Steel Structure on Outshore End of New Chicago Municipal Pier Simplified by Avoiding Arch Action in Radial Trusses

BY SHIFTING the point of support in designing the radial trusses supporting the hemispherical roof in the recreation building on the new Chicago Municipal Pier, cantilever instead of arch action, with corresponding simplification of the detailing, was obtained. In this way, by utilizing the framing outside of the main structure, arch thrusts at the semicircular ring used to connect the radial girders to the main arches were entirely avoided. Another special detail of this building is the unusual riveted trusses and curved steel framing used above the proscenium to support the roof and the plastered ceiling. In the Engineering Record of June 19, 1915, page 778, the general features of this record-breaking 292 x 3000-ft. pier were described, including the substructure and the pier sheds with elevated boardwalk leading to the recreation building at the extreme outshore or eastern end of the pier. This steel-frame building, which is here described, contains a public hall about 135 ft. wide and 150 ft. long, with arched roof and hemispherical end.

GENERAL DIMENSIONS

The span of the three-hinged arch trusses is 136 ft. 8 in., with a rise of 74 ft. 4 in. The rectangular part of the building on the west end is about 105 ft. long, consisting of four panels at 20 ft. with a 25-ft. end panel back of the proscenium. To support the arched roof there are four main three-hinged arch trusses and the special truss over the proscenium near the brick wall of the west end. On the east the semicircular end has a radius of about 59 ft., with a 24-ft. two-story outside extension carrying the promenade deck at the roof level. This two-story frame with its loading was utilized by connecting it with the curved radial trusses to insure cantilever action instead of arch action, as already mentioned.

The accompanying drawing of half-sections of the main trusses and this framing gives the principal dimensions and the materials used. A monitor 45 ft. wide and 7 ft. high extends over four panels and is carried around the semicircular end as indicated. The copper roof is attached to the $1\frac{1}{2}$-in. cinder concrete slab spanning the 5 ft. between curved channel rafters. These rafters are supported by plates above the longitudinal struts shown in the various sections and braced by the short bent rods at the ends, as indicated in the detail sketch.

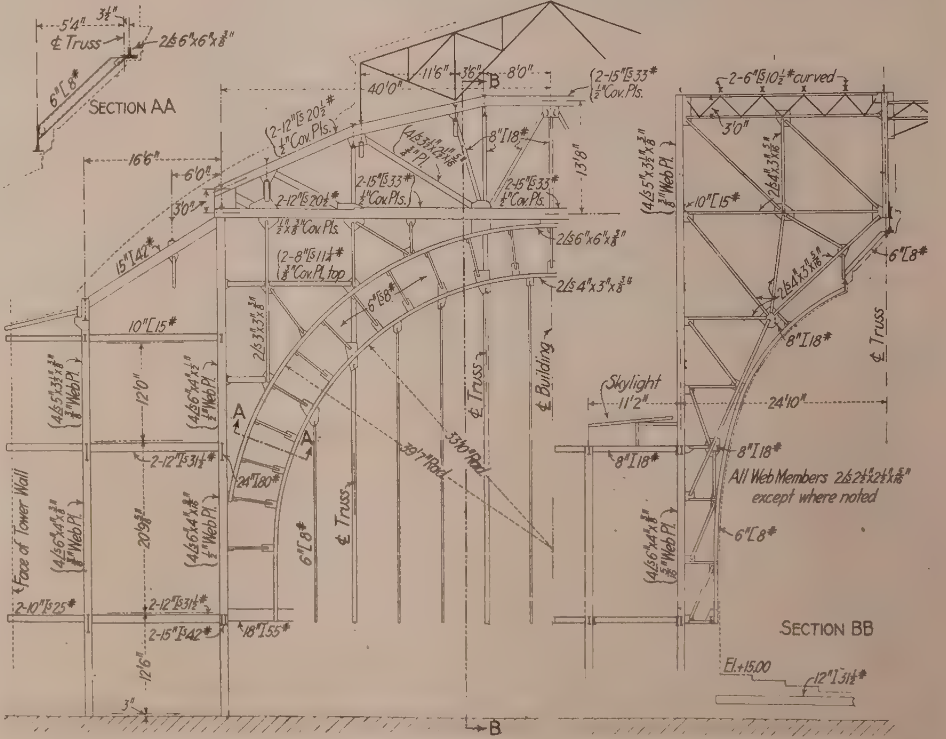
THREE-HINGED ARCH TRUSS

True arch action for the main roof trusses is obtained by the use of $2\frac{1}{4}$-in. round rods, with turnbuckles, placed below the floor. Built-up channel chords and four-angle web members with batten plates are used in these trusses. Stiff bracing of the knee-brace or portal type shown in the sections is placed in vertical planes 11 ft. 6 in. apart at the upper joints to stiffen the lower chord, while special braced struts are placed at the lower joints of this chord.

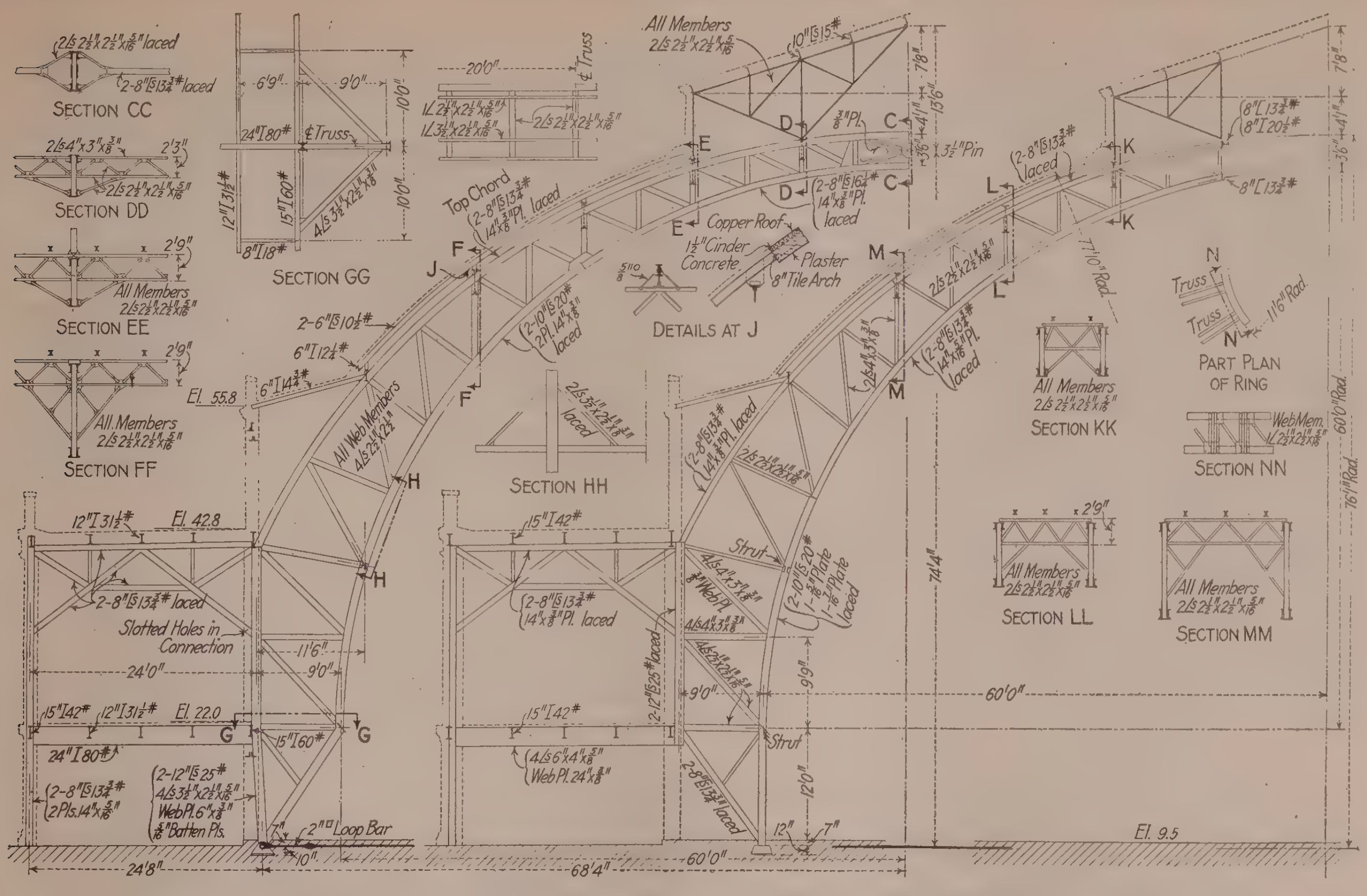
Although the stresses are small, the relatively heavy truss shown below the roof of the two-story extension for the promenade on the side of the building was designed to conform to the cantilever trusses in the circular portion, where these trusses form part of the trusses.

CANTILEVER RADIAL TRUSSES

On the same drawing with the half-section of the main three-hinged arch trusses is shown the modified truss used for the



HEMISPHERICAL ROOF SUPPORTED BY RADIAL TRUSSES AND CURVED RAFTERS



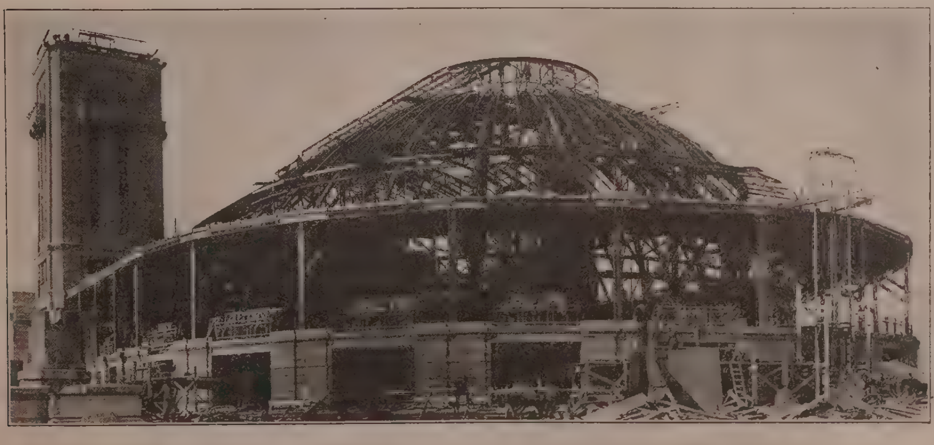
RADIAL CANTILEVER TRUSSES DIFFER FROM THREE-HINGED ARCH TRUSSES IN HAVING PEDESTAL AT INNER-CHORD LINE

hemispherical roof support. The simple expedient of combining this truss with the exterior two-story frame, with its loading, and placing the main pedestal at the inside or lower chord of the curved trusses, brought the center of gravity outside of this point. As a result the curved truss acts as a cantilever and is connected at the inner end to a ring truss about 4 ft. deep, as shown in the drawing. The stresses in the truss below the roof of the outside extension are much increased in comparison with the previous case, although the same sections are used except for the top chord, where a cover plate is added to the two-channel member.

Except for the three lower panels, the main web members of these radial trusses are of the two-angle type with tie plates, instead of the four-angle type used for the heavier main trusses. The stresses decrease rapidly toward the crown. The ring girder at the crown is used primarily to connect the ends of the cantilevers. It was realized that if the ends of these cantilevers deflected, a horizontal thrust would be thrown into this ring girder, which was designed to transmit it. The struts in the roof opposite the ends of the ring girder carry this thrust to some specially designed bracing back of the proscenium.

Proscenium Truss and Framing

The special truss near the west end of the building over the proscenium arch or domed ceiling is supported on columns about 60 ft. high, and carries the framework to which the plaster-on-metal lath is attached. Four light truss frames similar to that shown in section BB of the accompanying drawing frame into this truss at the main panel points, their top struts supporting the curved rafters for the roof of the main building. The upper-chord panel lengths vary quite irregularly in order to support the standard monitor truss similar to that used above the main arches. The use of I-beam web members should be noted.



PROSCENIUM TRUSS SUPPORTS FRAMING FOR CURVED PLASTERED CEILING

The design of the recreation building was made by G. Edward Gustafson under the direction of E. C. Shankland, chairman of the Harbor and Subway Commission of Chicago. W. A. Artingsall was harbor engineer, Earl Van Voorst was superintendent in charge of construction, and Charles S. Frost was the architect for the commission. The contractors were Paschen Brothers, of Chicago.

A Slip Scraper Romance

Buried treasure was found in excavating for the 7,500,000-gal. reservoir for Dubuque, Iowa, described in the Engineering Record of May 6, page 616, to the extent of $150 in silver coins, all more than fifty years old. The reservoir is located on Kelly's Bluff, the land formerly being owned by a miser of that name who for many years mined the limestone rock for lead, zinc and silver. Gold to the extent of $10,000 is reported to have been found several years ago in a cache left by the close-fisted Kelly. A short time before his death he sold ores to the value of $55,000 in Pittsburgh. He was paid in gold, but it still remains undiscovered. Many people have made unsuccessful attempts to discover his hoarded wealth. When, therefore, someone caught the glitter of coin in the earth being removed by an unromantic slip scraper, there was a rush and a scramble, and all who could reach the spot were soon busy picking up "pieces of eight." Dabney H. Maury, the consulting engineer who designed the reservoir, tells the story of a young miss who filled both hands with coins and then wept bitterly because she had no pockets.

Western Engineer Comments on Eastern Roads

Condition of Macadam, Concrete and Brick Roads and "Carpet Coats" in Maryland As They Appeared to an Experienced Observer

IT IS A QUESTION how much information about road systems, types and surfaces can be obtained by the layman riding in an automobile; that is, beyond a hazy recollection of a smooth or rough surface. T. R. Agg, professor of highway engineering of the Iowa Engineering Experiment Station, in May made an inspection of roads in Maryland and of the Chevy Chase Road in Washington. An account of what he saw appeared in the May-June *Iowa Service Bulletin*. It indicates what can be seen by an experienced observer. The following extracts from his notes relate to features of special interest:

"We left Baltimore over the main highway between Baltimore and Philadelphia, and as may be expected the portion of this highway near Baltimore is as heavily traveled as many city streets. The first 6 or 8 miles is asphaltic concrete constructed under open specifications with coarse mineral aggregate, which in this case was traprock quarried and crushed in the vicinity of the work. This surface is giving excellent service, and it is apparent that by renewing the seal coat from time to time the roadway will have a very respectable length of life. The remainder of the roads traversed were either water-bound macadam with carpet coats of asphalt or concrete.

"The entire distance traveled, which was approximately 250 miles, was on the state-road system, with the exception of one gap of 8 miles, which, however, is under contract. On all the roads the workmanship, especially on the wearing surface, is excellent. The surfaces are remarkably free from unevenness and depressions and have been maintained in a very commendable manner. The ditches and back slopes did not seem to be quite up to the standard of the wearing surfaces. This was perhaps due to the fact that the soil itself is quite unstable and that the trip was made so early in the summer that there had been no opportunity for the patrolmen to get the earthwork trimmed up. On many sections the shoulders along the traveled way had been dragged and were in excellent condition.

BREAKERS STOP EROSION

"An interesting detail of construction was noticed on many hills. Apparently the soil erodes quite readily, and in order to prevent the ditches from gullying, breakers or weirs had been constructed at frequent intervals so as to prevent erosion. Some of these were of concrete and others were merely planks. They seem to be very effective.

"The entire state-road system of Maryland is maintained by patrolmen, each patrolman caring for a section of from 4 to 8 miles of road, depending on the character of the surface. These patrolmen are permitted to employ additional help for certain kinds of work, and several fair-sized gangs were passed.

"The macadam surfaces are maintained by coating them with a bituminous material into which stone chips are rolled, and a feature of the Maryland work has been the use of 1-in. coarse-stone chips for this purpose. These carpet roads seem to be satisfactory for about two years and must then be renewed. But our observation leads us to believe that eventually the coat will be of sufficient thickness and stability to last three years. The cost per year for maintaining the 16-ft. macadam by this method is about $350 per mile, and the original cost is about $9,000 per mile. This includes the repair work done by the patrolmen, the upkeep of shoulders and ditches and the maintaining of the traveled way. Water-gas tar, native asphalt and oil asphalt have been used in the surfaces. It is apparent that the 16-ft. width is too narrow for many of the roads.

MUD SHAKERS

"Wherever the unimproved earth roads lead into the improved state roads, mud shakers are provided by constructing 100 ft. of rough macadam down the unimproved road. Most of the mud shakes off on the rough surface before the vehicle gets on to the improved road.

"The portion of the system constructed during the past two years has been of concrete, the roads being 16 ft. wide, some of them constructed with gravel concrete and some with broken-stone concrete. On all of these later roads the workmanship is excellent, the surfaces being remarkably free from unevenness that would impair the riding qualities. Expansion joints are constructed with a single thickness of tar paper, and are spaced 35 ft. apart. The roads all had a good many transverse cracks in the concrete, but relatively few longitudinal cracks. There are more cracks in the gravel-concrete roads than in the broken-stone concretes.

"Limestone aggregates have been used successfully in the concrete, but the limestone is a tough blue stone much better than anything found in Iowa. Gravel has been much more widely used than has the broken stone. On account of the system of maintenance the concrete along the cracks is not breaking down and the cracks do not impair the riding qualities. In a number of places we found sections of concrete pavement upon which an attempt had been made to construct a carpet coat. On some of the roads the coatings were in a very good condition. This is particularly true over a 6½-mile stretch of tar-coated concrete on the Berlin Road which was constructed in 1912. Since that time only 2 bbl. of tar have been used in patching. The surface is in excellent condition. Good tar was applied soon after the concrete was completed, the surface being coated with about ¼ gal. of tar broomed on, another ¼ gal. of tar applied and chips spread and rolled in. In other words, a carpet coat was built up in the same manner as was employed on the macadam roads. This road will need a new carpet coat this year. These roads show clearly the possibilities of maintaining the surfaces in excellent condition by systematic maintenance.

"An interesting development of traffic is the motorbus service along the roads on the 'East Sho'.' Railroad service is not very good in this district, and the motorbuses have regular schedules all the way down the East Shore roads.

"In addition to good construction, these roads throughout show what can be accomplished by the application of correct principles of engineering. They are uniformly well designed, generally with long-radius curves, always with a clear view ahead, and the provisions for drainage are for the most part entirely adequate. Probably 25 per cent of the road is underdrained, a great deal of it having two lines of tile, one under the side ditch. Guard rails have been very widely employed, and in some instances guard fences of substantial construction have been used. The concrete surfaces of the single-course type cost about $10,000 per mile.

CHEVY CHASE ROAD EXPERIMENT

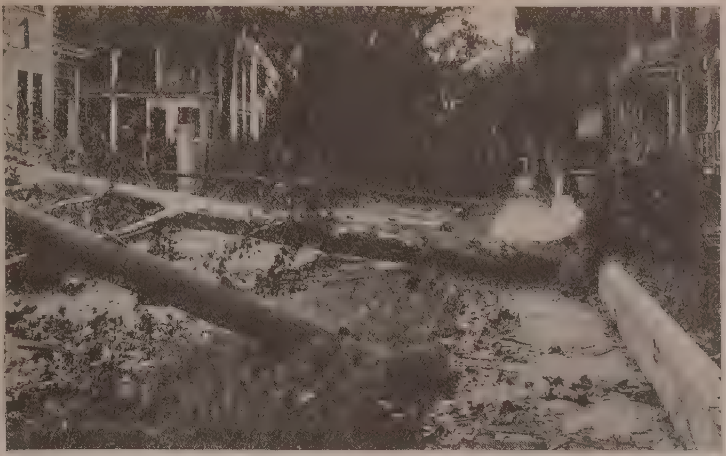
"One of the most important sections of experimental roadway that have been constructed in this country is the Chevy Chase Road, constructed by the U. S. Office of Public Roads. On this road there are a number of sections of concrete construction and a number of sections of brick. The concrete is three years old, and a number of sections were coated with bituminous material soon after construction. Most of these bituminous coatings are entirely gone at this time, but no attempt has been made to maintain them. The concrete is cracked transversely at intervals varying from 20 to 120 ft., but about 60 ft. seems to be the average distance between cracks.

"The gravel concretes have more transverse cracks than the limestone concretes. So far as the wear is concerned there is as yet no apparent difference between the limestone and gravel, but here, as in the case of Maryland County roads, the limestone is a tough blue stone. The cracks are not being maintained, and the concrete along them is breaking down somewhat. The paving carries mixed traffic, a part of it consisting of heavy loads on steel tires drawn by shod horses. In general this experimental road shows conclusively that with proper maintenance the concrete will have very long life. One-course construction was employed for the concrete.

"The sections constructed of brick are all in excellent condition, although the brick varied in quality from those having a rattler loss of 16 to those having a loss of 30 per cent. The latter, of course, show more wear than do the former. There are a few longitudinal cracks on both the concrete and the brick sections of this road, but none of them is serious."

Cement Company Uses Shell Deposits

The extensive shell deposits along the Gulf Coast are being utilized by the new plant of the Texas Portland Cement Company at Manchester, near Houston, Tex., in the manufacture of cement by a wet process recently developed by the F. L. Smidth Company, of New York City. Difficulty in using shells, which when properly prepared contain the purest lime constituent possible for cement making, has been heretofore experienced because no successful process had been discovered whereby the shells could be pulverized preparatory to mixing with the alumina and silica constituents. The new plant, which is one of the most modern cement plants in the country, has turned out in the first two months of operation about 50,000 bbl. of cement. Shipments under the direct supervision and re-check of the engineers of the Pittsburgh Testing Laboratory have recently been started. By using oil for fuel and kaolin from the numerous deposits in Texas it will be possible to produce pure white cement. Plans and contracts for the plant were prepared by H. Struckmann, of Kansas City, Mo., the company's consulting engineer.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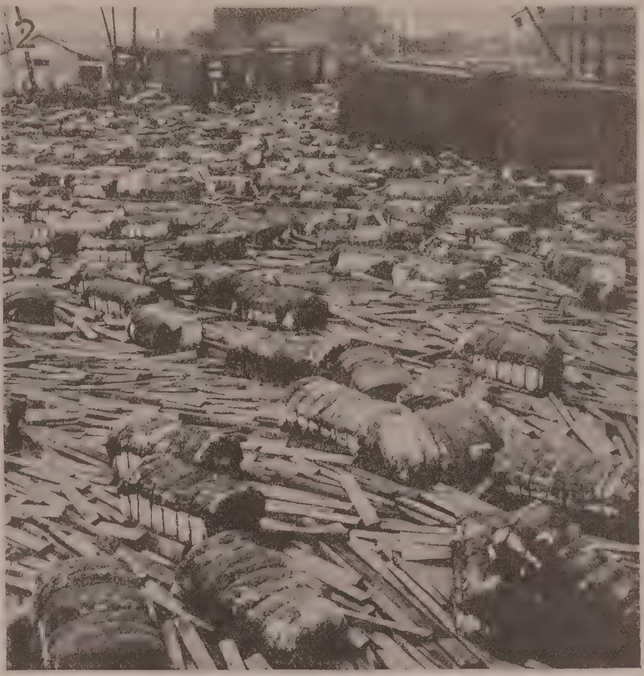
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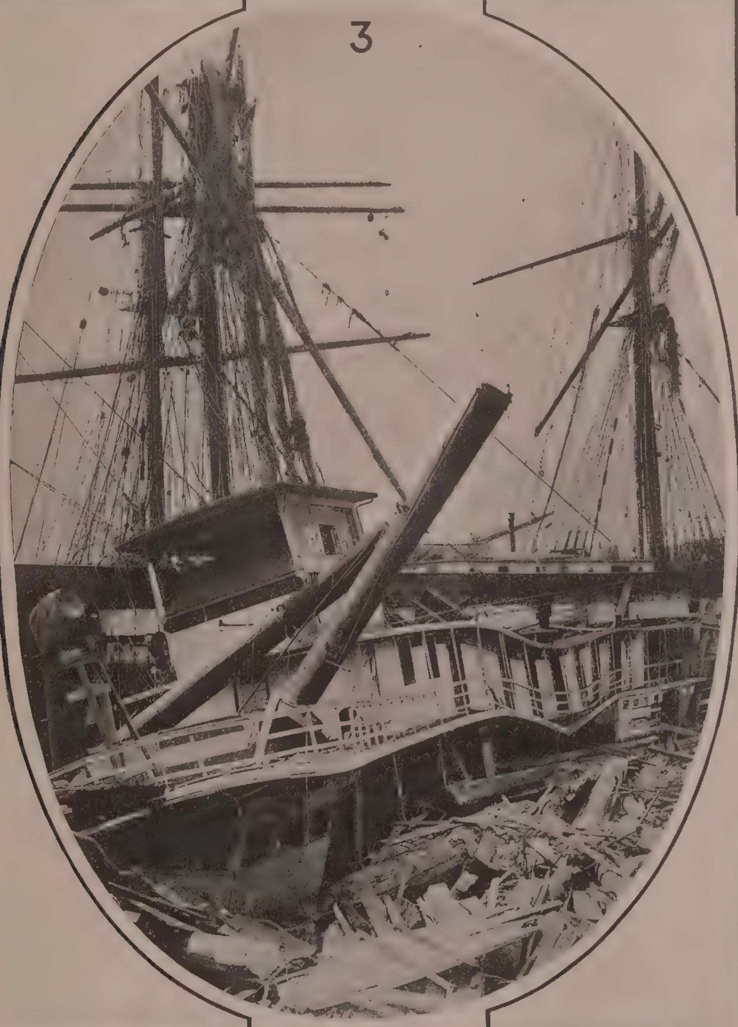
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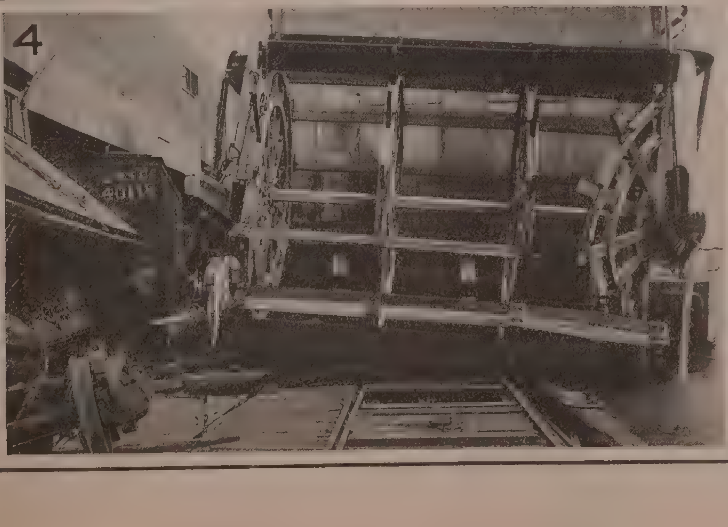
Photos by Overbey's Studio, Mobile.

107-Mile Gale and Terrific Floods Make Mobile a Tangle of Trees, Ships and Débris

THE TROPICAL STORM sweeping over Alabama and Mississippi July 5, driven by a 107-mile-an-hour gale, carried away bridges, destroyed railroad and telegraph lines and turned the streets of many cities into miniature Venices. The storm centered over Mobile, where the damage is estimated at $2,212,000. Ships were driven from the bay 2 miles up river; heavy coal and lumber barges were tossed around like chips and driven ashore on the tracks of the Louisville & Nashville Railroad. A section of the Pinto drydocks, with a tugboat still on the ways, was found nearly 2 miles from its home. Telephone poles and sturdy trees were uprooted and tossed about with the result shown in picture 1. A fitting caption for 2 might be "Cotton and Lumber Everywhere." The cotton and lumber loss at Mobile is given at $160,000. Picture 2 was taken near the Southern and Mobile & Ohio railroad piers. The U. S. dredge Hennen, in picture 3, was driven ashore at Choctaw Point and further damaged by the ships in the background. The vessels are in 1 ft. of water; they draw 11 ft. The wreck at the Mobile & Ohio Railroad wharf at Government and Dauphin Streets (picture 4) helped to bring the total damage to wharves and ships to $454,000. Picture 5 was taken at Dauphin and Front Streets after the storm. It shows a small part of the $960,000 buildings loss.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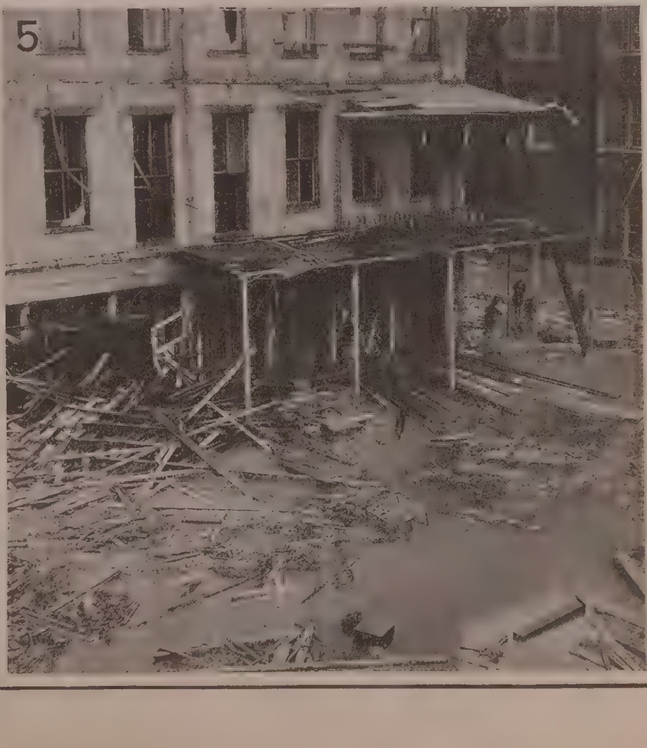
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MAKING A QUICK TRACK SHIFT WHERE STREET RAILWAY CROSSED STEAM ROAD

Drainage Drifts Have Apparently Stopped Slides at Hillside Grade Separation

Elimination of Rookwood Grade Crossing of Pennsylvania Lines and Eastern Avenue at Cincinnati Introduces Variety of Problems

By H. G. WRAY
Pennsylvania Lines West of Pittsburgh, Cincinnati

DRAINAGE DRIFTS of coarse rock have apparently stopped the slides on a clay hillside along the Ohio River, precipitated by the shifting of tracks and avenue into the hillside to eliminate the Rookwood grade crossing of Eastern Avenue and the Pennsylvania Lines West of Pittsburgh. Because of the great skew of this crossing, the presence of a street car line on the avenue, the existence of a 60-in. water main that had to be bridged by the masonry, and the necessity for keeping the avenue as well as the steam and electric railroads open at all times, the separation of grades at this crossing was a complex problem, even without the slide difficulty.

The breaking of the water main necessitated a change in the design of a neighboring sewer and delayed the work in general, and other minor adjustments had to be made to meet the conditions that arose. The slide trouble was the main problem, but it is believed that the drainage drifts have solved it, and without the use of expensive masonry or makeshift piling.

ONE AVENUE CROSSED TRACKS THREE TIMES

The tracks of the Southwest system of the Pennsylvania Lines West of Pittsburgh, after leaving the Pennsylvania Station at Cincinnati, parallel the Ohio River for several miles to the northeast and cross Eastern Avenue, the main thoroughfare to the eastern part of the city, three times. The first of these crossings is located about 1.3 miles east of the station, and is known as Rookwood crossing. This crossing was considered very dangerous on account of the enormous amount of street car, pedestrian and vehicle traffic. The railway-transfer and classification yards, shops and roundhouses were located east of this crossing, and railway traffic to and from these facilities was exceedingly heavy. Accordingly, when grade-separation work was taken up by the city in 1904 it was decided to eliminate the Rookwood grade crossing first.

In connection with the elimination of this grade crossing it was thought desirable to provide a foot subway at Brooklyn Street, about 1500 ft. east of Rookwood, as this street had connection with the suburban district on the hilltops by means of steps.

The first ordinance authorizing the elimination of these grade crossings was passed in 1905. Plans were prepared by the railroad company in co-operation with the city engineering officers and were approved and accepted by the city, and invitations were out to bidders in 1906.

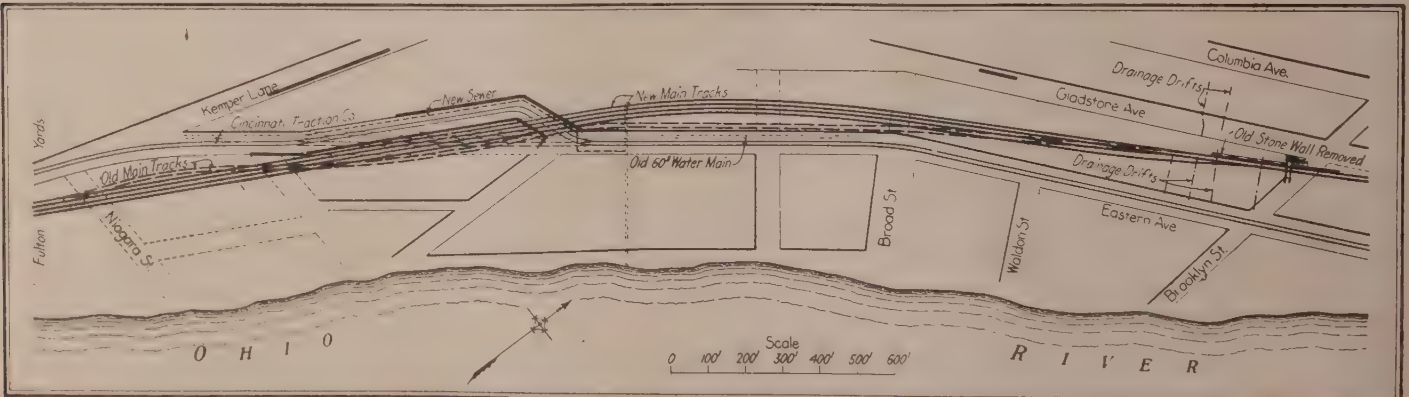
Because of the small angle of intersection of Eastern Avenue with the present tracks it was practically out of the question to carry the avenue under or over the tracks in its present location, as this would have necessitated the building of a very long bridge, probably of viaduct construction, with several rows of columns offering an obstruction to traffic. In order to avoid the necessity of a bridge of this type the plans for the proposed improvement provided for a relocation of Eastern Avenue and the present tracks, making it possible to carry the avenue under the tracks at a better angle, with only a single row of columns in the center of the roadway.

In the spring of 1906 a corps of engineers was in the field preparatory to starting the construction work, when the citizens of the East End raised objections to the proposed relocation of Eastern Avenue, and also to the row of columns supporting the bridge in the center of the roadway, and by means of city council proceedings secured an annulment of the ordinance authorizing the proposed construction. No further action was taken in the matter until the spring of 1916, at which time it was decided to start the work as provided for in the original plans of 1906.

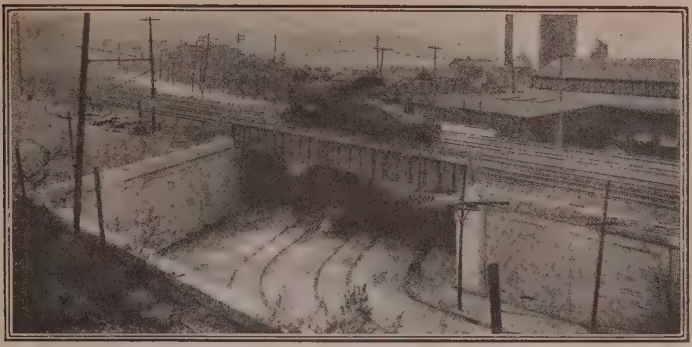
SHIFT BOTH TRACKS AND AVENUE

In order to relocate this part of Eastern Avenue to secure a more desirable intersection with the railway tracks, it was necessary to cut away the foot of a steep hillside rising to the northwest from the present main tracks. The plans called for a heavy mass wall along the entire length of Eastern Avenue, as relocated to protect it from the encroachment of the hillside. It was found to be impossible, however, to construct this wall for the entire length as called for on the plans, because of the excessive cost entailed by extending it to meet a solid foundation, which could be found in some places only at a very great depth.

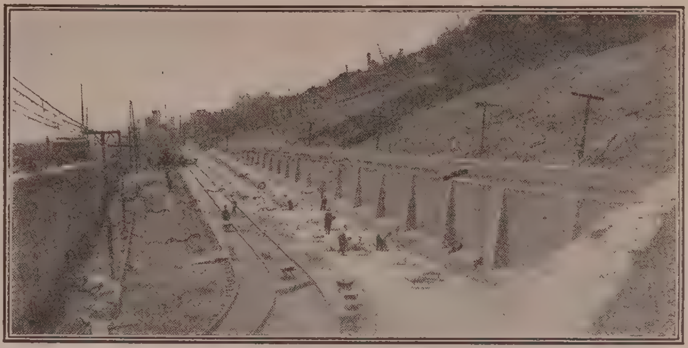
All the residence property along the hillside was acquired and removed previous to the starting of this improvement, for it was believed that the entire hillside would be affected by the removal of such a large part of its base. Shortly after steam-shovel excavation had started along the foot of the hill large cracks began to appear in the surface of Kemper Lane, which, as the plan shows, is up the hill from Eastern Avenue. In order to hold up this street and protect the property along its north side from future damages, a reinforced-concrete retaining wall was built along its south side, as shown on the general plan. This wall was extended to overlap that part of the mass wall along the north side of Eastern



RELOCATION OF TRACKS AND AVENUE MADE IT POSSIBLE TO AVOID PROHIBITIVE SKEW—NOTE LOCATION OF WALLS AND DRAINAGE DRIFTS



NEW UNDERCROSSING GIVES 15 FEET HEADROOM FOR STREET CARS



LOOKING UP SOUTH APPROACH—BUTTRESSED MASS WALL ON RIGHT

Note Kemper Lane retaining wall in right background of left-hand view

Avenue previously constructed at the foot of the hill, where solid foundation was found at a reasonable depth below the surface.

A retaining wall was built along the south side of Eastern Avenue to hold the embankment for the railway tracks. This wall and the mass wall along the north side connected with the bridge abutments on either side.

By beginning at a point 1500 ft. west of the crossing and raising the tracks on a 1 per cent grade, it was found possible to secure a rise of 6 ft. at Rookwood. Continuing northeast from Rookwood on a 0.38 per cent grade, the old grade and alignment were intersected in the vicinity of Brooklyn Street. The street profile was determined largely by the necessary depression of Eastern Avenue to give an underclearance of 15 ft. to allow for the passage of trolley cars and the minimum feasible floor depth of 3 ft. 10 in.

BRIDGE FLOORS AND WATERPROOFING

Columns in the center of the street at the Rookwood crossing divide the bridge into two separate spans of 30 ft. 6 in. each. A trough-floor bridge with fascia girders was used with a floor depth of 3 ft. 10 in. The longitudinal troughs running perpendicular to the abutments were filled with concrete and covered over to a depth of 3 in. The waterproofing material consisted of four-ply asbestos waterproofing felt and one layer of waterproofing fabric thoroughly cemented together with a waterproofing asphalt. This material was placed on the top layer of concrete and covered over with a 1½-in. coat of sand mastic.

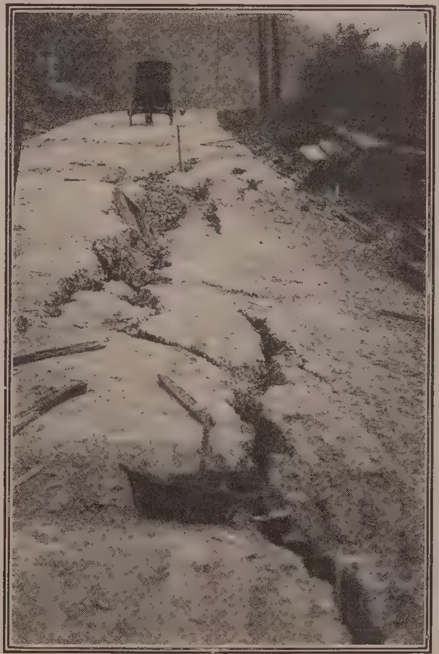
Three layers of hydrex felt coated with a hydrex compound were placed on the barrel of the Brooklyn Street arch extending down to the springing line on either side. The backs of the stairway walls at Brooklyn Street, as well as the backs of the retaining walls and abutments at Rookwood, were waterproofed with two coats of tar paint.

DRIFTS WERE SHEETED WITH 2-INCH OAK

HANDLING TRAFFIC

It was necessary to keep Eastern Avenue open to traffic at all times during the progress of the work, as this street was practically the only available outlet to the eastern section of the city. Because of the extremely hilly character of the surrounding territory it was impossible to reach the numerous industries located in the East End by any other route.

As may be seen from the general plan, it was possible to build the greater part of the two abutments in the clear of the existing main tracks, which were trestled over the new location of the street to provide for its depression. The walls on the north and south sides of Eastern Avenue were also built without interfering with traffic. However, a section of the wall on the south side was omitted where it crossed the existing street, and was filled in later when traffic was diverted over the new relocated street.



CRACKS THAT OPENED UP IN KEMPER LANE

The approach and subway grades were established and the street railway tracks were laid in their new location up to points on either approach where they could be conveniently connected to the old tracks.

The north half of the Rookwood bridge was erected and the railway company laid its track on the new alignment where it was possible to do so in the clear of its present main tracks. It was possible to lay the track on the new alignment from Brooklyn Street to Niagara Street, except that part intercepted by the street railway tracks in their old location.

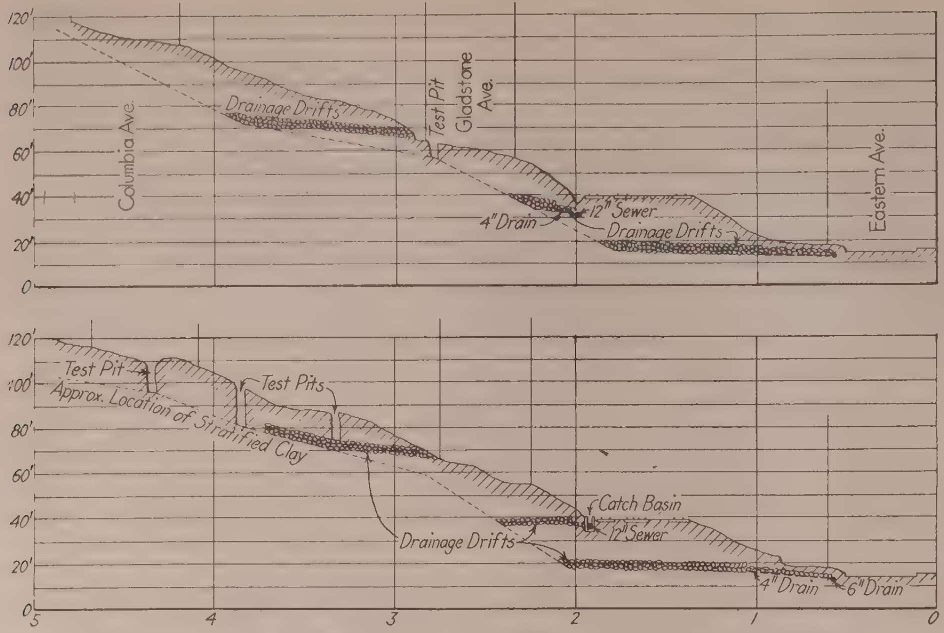
It was decided to shift traffic to the new work at night time, as all traffic was considerably lighter at that time. The railroad company with three gangs of track workmen cut the present main tracks at Brooklyn and Niagara streets and shifted them over to meet the new tracks previously laid. The street railway company's forces connected its old tracks with the new at the top of each approach, and took up the section of its old tracks intercepted by the railroad tracks on the new alignment. The railroad company's forces then closed this gap in its new tracks, making a continuous route from Brooklyn Street to Niagara Street over the new alignment.

The shifting of traffic from the old to the new work was accomplished in approximately 10 hr., with little or no hindrance to railway or street traffic.

60-INCH WATER MAIN MAKES TROUBLE

The 60-in. water main shown in the plan and profile proved to be a very troublesome and costly factor in the prosecution of the work. Notwithstanding that provision had been made for future improvements of this nature when the main was first laid, it was necessary to make special provisions for crossing it with the masonry in two places and the main tracks in another. At the

COARSE ROCK USED TO BACKFILL DRIFTS



THE DRAINAGE DRIFTS WERE RUN IN TO THE SURFACE OF THE STRATIFIED CLAY

masonry crossings concrete walls were carried down to rock on each side of the pipe, and a reinforced concrete slab was built over the top of the pipe to relieve the main from additional pressure caused by the masonry above it. A covering of heavy creosoted timber was placed over the main where it was crossed by the main tracks, in order to avoid any shocks that might be transmitted by heavy trains.

The original plans called for the construction of a 24-in. sewer along the north side of the east approach in close proximity to this main to drain the subway. Every precaution was taken in the performance of this work to protect the water main from the possibility of settling.

In December, 1913, only a few months after the work had been in progress, this main broke, flooding the sewer trench previously mentioned. Three workmen, who were unable to escape the enormous quantity and force of the water pouring from the break, were drowned. This unexpected catastrophe caused great damage and subsequent delay to the work in general. The sewer layout had to be revised and was constructed, as shown on the general plan, so as to cross on top of the main, where it was not necessary to excavate to any great depth. Two prominent consulting engineers made separate investigations as to the cause of the break in the main, and their reports exonerated the contractor and railroad company from contributing to the cause of the disaster.

TROUBLE FROM SLIDES

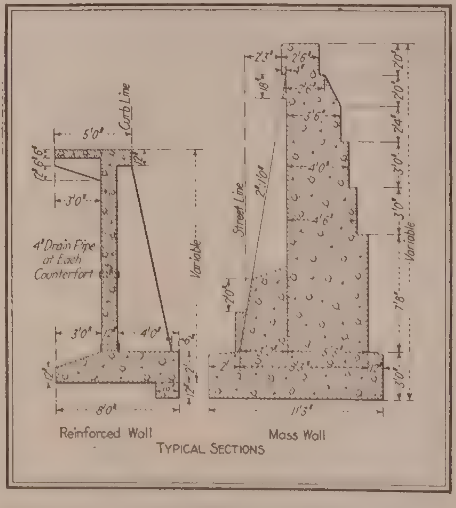
From Rookwood crossing to Brooklyn Street the new tracks were located to the northwest of the existing tracks. This new location again necessitated the cutting away of part of the hillside, which rose rather abruptly from the existing main tracks. Several test pits dug into the hillside disclosed a peculiar formation. The entire hill consisted of a soft clayey material resting on a layer of stratified clay mixed with limestone, which dipped at a very abrupt angle toward the river.

At the first cut of the steam shovel, in preparing the new subgrade for the railway tracks, serious cracks developed in the hillside, endangering the block of houses near Brooklyn Street. The plans called for a new concrete retaining wall to replace the stone gravity wall just west of Brooklyn Street. Previous to this new improvement this old stone wall had been moving toward the tracks, and on several occasions had to be cut away in places to clear the existing main tracks. From test pits dug in the vicinity of this old wall it was discovered that this layer of stratified clay was more than 20 ft. below the surface, and to build a wall of such depth would be very expensive.

Meanwhile the foundations of ten or fifteen houses began to give evidence of the sliding action of the hillside, as large cracks began to appear in them, damaging the property to a considerable extent. In view of these houses being damaged when the construction had barely begun, it was decided to buy the property and omit the construction of the retaining wall.

CRACKS APPEAR IN COLUMBIA AVENUE

During the rainy season of the next year following the purchase of this property the sliding action of the hillside increased and cracks developed in the surface of Columbia Avenue, making it necessary to take steps to protect the street. A retaining wall was first considered along the south side of this street, but it was found possible to secure a good foundation only by extending it to a depth of 35 ft. or more, and the cost of such a wall was considered excessive. Preparation was made to pin the hillside down with piling, but it was agreed finally that this method was only a temporary expedient at best.



MASS WALL ALONG EASTERN AVENUE AND REINFORCED-CONCRETE WALL ALONG KEMPER LANE

After a thorough investigation into the cause of this sliding of the hill it was concluded that insufficient drainage was responsible to a great extent. The ground water, finding no outlet through this layer of stratified clay, had a tendency to spread out over it and saturate the clay-like material above, causing the latter to break loose and slide in great volumes over the surface of the substrata. It was decided, therefore, to drain the hillside to see if this would stop the sliding.

DRAINAGE DRIFTS DECIDED UPON

Drainage drifts were driven through the hillside at frequent intervals to provide outlets for the ground water and to eliminate as far as possible its spreading out over the surface of the substrata. These drifts were driven in the form of miniature tunnels, as shown in accompanying cross-sections of the side hill, and were 4 ft. high by 3 ft. wide. As the digging progressed each drift was sheeted at the top and sides with 2-in. oak plank. Two men working in each drift were able to drive between 2 and 4 lin. ft. of tunnel per day. One man removed the material, while the other hauled it to the mouth of the tunnel by wheelbarrow.

In order to provide light for working an electric conduit was threaded through the drift as the work progressed. Lights were tapped off this line at easy working intervals.

After the completion of the drift it was backfilled with coarse rock in order to allow the ground water to flow through it.

These drifts were of varying length, owing to the character of the material encountered. They were, however, driven in each case until the underlying stratified clay was reached. As shown on the general plan, some of them are below the tracks and extend up into the hillside north of the tracks. Each drift was given an outlet to a sewer by a 4-in. drain-pipe connection. They were driven at an average cost of $5 per linear foot. This scheme of underdrainage has materially relieved the situation, and it is believed that it will be a successful undertaking.

Two years after the work was started, and while the drainage drifts were under construction near Brooklyn Street, a surface talus of 5-ft. depth started to erode and slide from Gladstone Avenue, between Broad and Waldon streets. It was decided more practical in this case, since the slide was of comparatively shallow depth, to build a retaining wall to hold the hillside in place.

The concrete masonry work at Rookwood crossing and Brooklyn Street, and all street grading and paving at the former place were done by the Marquette Construction Company of Chicago. Half of the Rookwood bridge was erected by the Ketler Elliot Construction Company, also of Chicago. The Rookwood bridge was waterproofed by the Johns-Manville Company of Cincinnati. The railway company's forces did all the track work in connection with the improvement and erected the remaining half of the Rookwood bridge.

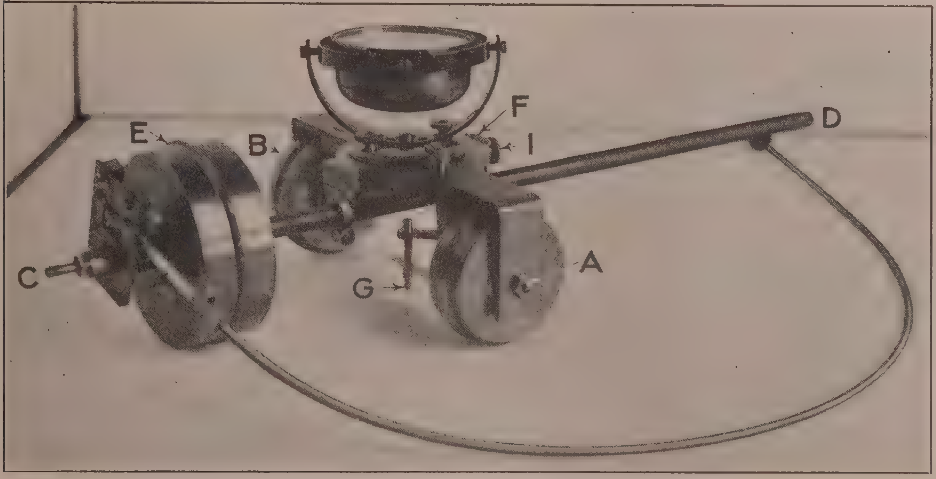
The work was carried on under the supervision of Thomas Rodd, chief engineer, Pennsylvania Lines West of Pittsburgh. E. E. Stetson was the engineer in immediate charge of the work.

Device Maps Route of Boat in Sounding Operations

Autoplanograph, as Instrument Is Called, Is Useful Where Fine Degree of Accuracy Is Not Essential

IN an article in the Engineering Record of July 22, page 109, attention was called to three devices developed by Agustin Mercau, an engineer of the Argentine Republic, to facilitate hydrographic work. The Profilograph, for taking and recording profiles of underwater surfaces, was described in that article. This article describes the Autoplanograph, which maps to scale the route traversed by a boat. The apparatus consists of a system of horizontal axles, two in number, 90 deg. apart. One, marked *AB* in the accompanying illustration, is shorter than the other, and carries two wheels—one at each end—of equal diameter, that can rotate freely. They are placed in such a manner that they support a small platform, upon which is located a sea compass or an electric gyroscope.

The other, of greater length (*CD*), carries on one of its extensions a wheel (*E*) of greater diameter, so placed that it can rotate freely. It rests on two cushions, through which it passes under the platform, and is provided with a regulating screw. One of the cushions can be made to serve also as a regulating screw by means of a small metal sheet (*F*) provided with a compression screw (*I*).



AUTOPLANOGRAPH GRAPHICALLY RECORDS THE ROUTE TRAVELED BY BOAT

APPARATUS PLACED ON TABLE OR PLANED BOARD

The apparatus is placed above a table or a planed board that serves as a support for it. Upon this is placed the sheet of paper on which the journey is to be sketched.

Attached to the lesser axle, and corresponding with the point of intersection of the two, there is a pencil (*G*) that is so placed that it can be raised at will from contact with the paper. The border of the wheels is cut in such a manner that the apparatus can not stop above the paper. Corresponding with the extremity (*N*) of the magnetic needle is an index fixed to the case that contains it. It is therefore possible to keep the greater axle of the apparatus in one fixed direction, the north magnetic in the case of the compass and the true north in the case of the gyroscope. By means of a flexible transmission (*H*) like that used by dentists (activated by a velocimeter, the movement of the boat or other means) it is possible to give the greater axle a movement of continuous rotation, which, in turn, places the pencil in movement parallel to the greater axle.

Under these conditions the lesser axle, and, in consequence, the pencil, is given a velocity proportional to that of the boat, and the greater axle is kept in a fixed direction—that of the north magnetic or of the true north. The journey recorded by the pencil, and its angular displacement, will be in accordance to that of the boat. The scale of the map so obtained will depend solely on the relation of the two velocities, which is easily obtainable with the simple features that are provided with the apparatus for such an object. The scale may be of any design whatever, or one determined in advance.

MAINTAINED IN CONSTANT DIRECTION

In order to maintain the apparatus in the constant direction before mentioned, the operator, when he uses a compass, should move the large wheel so that the fixed index coincides constantly with the north end of the needle.

When the journey is so extensive that the pencil and the lesser axle of the apparatus have advanced near to the extremity of the greater axle, the small compression screw makes it possible to quickly disengage the metallic binder and to bring them back to the beginning. Likewise, when the plane to be covered is extensive and exceeds the dimensions of the paper, and, for this reason, the apparatus has to be lifted, it can be raised and placed in another position without any inconvenience whatever, since it remains always oriented and the two parts of the journey can be tied together easily. There is also attached to the apparatus a small telescope that permits it to tie in to points on the coast or fixed marks.

The instrument has been used by the inventor with excellent results on the River Plata and in the canals of the delta of the Parana, and has been found very useful for work in which a fine degree of accuracy is not necessary.

Correction for Drawing of Details of Brooklyn Elevated Railway

The drawing of details of the Brooklyn elevated construction on page 83 of the issue of July 15 contained an error in stating the size of main flange angles for the 50-ft. longitudinal girders. These angles are 6 x 6 x 7/16 instead of 6 x 6 x ⅞.

Tree Planting Would Give New York a Park System

City's Parks Can Be Connected by Utilizing Existing Streets in Such a Manner as to Give a Unique Park System

A PARK SYSTEM is an important feature in most modern American cities. Though the pioneer among American cities in creation of public parks and the owner of some of the most magnificent individual park areas in the land, New York City possesses neither a park system nor a definite plan for the creation of such a system. These facts are brought out by Prof. L. D. Cox of the New York State College of Forestry at Syracuse University, in a report on a street-tree system made to Cabot Ward, park commissioner for the boroughs of Manhattan and Richmond. As a remedy it is suggested that certain streets be selected and so planted that they would co-ordinate the existing scattered park areas and give to the city a park system unique among American cities.

CAREFUL SELECTION OF STREETS NEEDED

In all the boroughs of the city save Manhattan the opportunity exists for working out a park system with the usual park connections, and doubtless all of these boroughs will some day possess, in a greater or less degree, such systems. In Manhattan, however, due to the intensive use of all available real estate, a park system by means of the ordinary forms of park connections appears to be practically impossible. If a system of connecting ways is to be secured at any reasonable outlay, the existing streets must be utilized in some form.

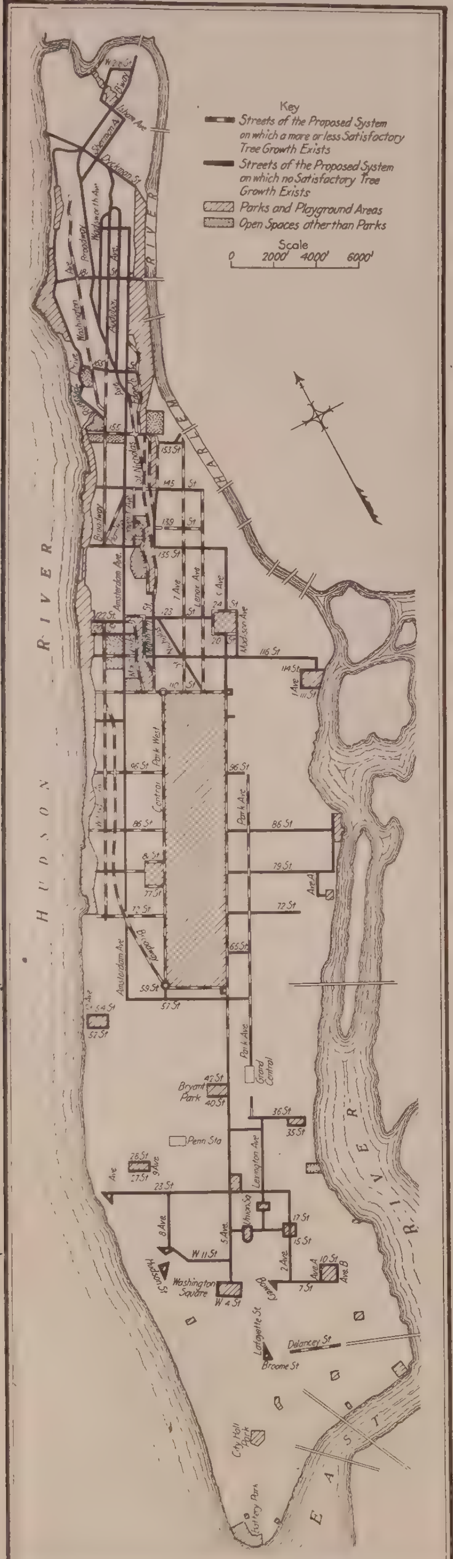
By choosing streets which will permit of successful tree growth, and by securing in the planting design a reasonable degree of interest and individuality, a park system exceptional among American cities may be secured. Such a scheme of street planting would not only co-ordinate the existing scattered park areas of the borough into a comprehensive system, but would also impart that peculiar or individual character and beauty which is necessary if Manhattan, the heart of New York City, is to take its place among the beautiful cities of the world.

It has been found possible, after a careful study, to select streets suitable for interpark connections upon which successful tree growth of one form or another may be secured. These streets are suggested for the proposed street-tree system, and are shown in the accompanying map. By concentrating upon certain streets it will be possible, with a reasonable annual expenditure, to secure a condition of tree planting in Manhattan which will give it the appearance and charm of a tree-shaded city.

CONSIDERATION GIVEN TO FUTURE CONDITIONS

In selecting the streets to be used, careful consideration was given not only to the existing conditions of the streets in question but also to their future development. The latter was largely determined by the proposed scheme of districting being worked out by the City Planning Commission.

The streets of the proposed street-tree system are confined almost entirely to those streets which lie in the districts limited to residential or restricted business—retail stores, offices, etc.—and residential purposes. Several streets which it would be very desirable to include in the system, and the present condition of which would permit of tree growth, have not been so included because they lie within the proposed unrestricted districts, where the ultimate development would probably render tree growth either impossible or at least unsuccessful. These few streets are indicated separately upon the map, and if by any chance the proposed districts could be slightly changed so as to exclude them from the unrestricted districts they should be added to the system.

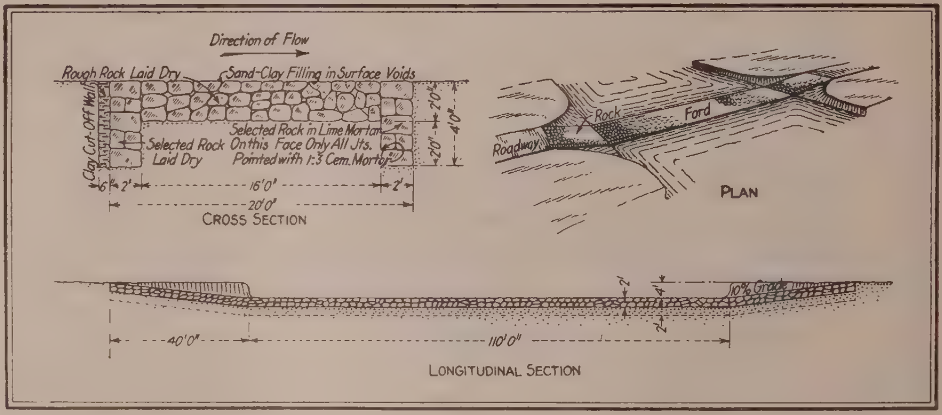


STREETS WITH SATISFACTORY TREES AND OTHERS WHERE THEY ARE NEEDED

There are, of course, other streets not comprised in the system of inter-park connections, but upon which trees may be grown successfully. These are streets which will lie in the restricted residential districts. The program should be to encourage tree planting by private owners upon these streets and public planting should be carried out upon them after the main system has been completed.

Ford Crosses Sandy Wash

A BROAD wash in Washington County, Utah, known as the "Two and a Half Sandy Wash," is crossed by a stone ford constructed the full width of the wash. Stone was obtained on the site and was laid in place with cement mortar. In this country, where road construction is difficult on account of the general ruggedness of the topography, and where the people are scattered and funds are scarce, bridges are entirely out of the question for these sandy washes.



THIS TYPE OF FORD CAN BE USED WHERE NO FUNDS ARE AVAILABLE FOR BRIDGES

The ford was designed in the office of E. R. Morgan, state road engineer.

Excavating Machines and Overhaul

Specifications for Overhaul Should Take Into Account the Type of Equipment to Be Used

By G. B. MASSEY
George B. Massey Company, Chicago, Ill.

THE OVERHAUL clause in contracts for ditch and levee work needs careful consideration from the point of view of what actually constitutes overhaul work for the type of excavating equipment to be employed. Overhaul can no longer be accurately allowed for by following the clause evolved in the days when such excavation was done by teams, scrapers and wagons. This outgrown clause would usually state that if the average haul of all the material moved were found to exceed a given distance, the contractor would be paid for overhaul at a certain rate per cubic yard per 100 ft. for the entire mass, for such distance as the average haul might exceed the specified distance allowed as a reasonable free haul.

At present, however, most work of this nature is done by dragline machines, small dipper dredges and other equipment having a definite radius of action. Such machines are able to dig material within a certain area and deposit it at a certain distance without changing the location of the machine. Moreover, in the case of the dragline it is often possible to handle the material once, move the machine to a new location and handle the material a second time, thus depositing it farther from its original location than the radius of action of the machine. In the case of dredges, on the other hand, and of other machines which do not swing through a full circle, the material may only be disposed of by depositing it on the two banks of the ditch or in the levee section directly at the side of the borrow pit.

It is evident that to require the contractor using such a machine to move material a greater distance than can be accomplished in one handling is not conducive to low bidding. With any of these machines it is almost as economical to move material 600 ft. as to move it even a very short distance beyond the radius of action of the machine. Practically, the material must be loaded in wagons of some description and hauled. If it is necessary to use teams, it is rarely possible to bring their carrying capacity up to the handling capacity of the machine, and the work is slowed down. Moreover, additional plant of an entirely different nature from the actual excavating equipment is required.

Consequently, after a decision as to the type and size of machine most suitable for the work has been reached by the engineer in charge, the overhaul clause should be adjusted to include everything beyond the radius of action of the machine. This will tend to reduce the cost per cubic yard of the work. For example, if a dragline machine with a 50-ft. radius is used, the overhaul should start at 100 ft. with a substantial increase, this increase to be further enlarged by small increments for distances beyond 100 ft.

On most jobs the overhaul expense is small compared with the total cost of the excavation. It is therefore manifestly unwise to penalize, by using an outgrown provision, the large yardage of straight work because of the small yardage of overhaul.

Motorbuses for Lincoln Park to Be Low and Light

A new design of motorbus is to be used by the Chicago Motor Bus Company, which is to operate in Lincoln Park, Chicago. The drive will be on the front axle to minimize skidding. The bus will be 1000 lb. lighter than electric or gaso-electric cars usually used for this purpose. There is to be no equipment under the body, thus making possible a car sufficiently low to clear trolleys.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

How Not to Use the Oxyacetylene Torch

By WILLIAM G. BROADHURST
F. R. Long-W. G. Broadhurst Company,
Hackensack, N. J.

UNDER CERTAIN conditions where the heat was dissipated too rapidly, the writer has found that the oxyacetylene flame loses its effectiveness. The experience gained in three instances where circumstances made a proper application of the frame difficult will perhaps be of interest to contractors.

While putting a new set of tubes in an ordinary vertical hoisting engine boiler, out on the job during cold weather, four of the bridges of the upper crown sheet were cracked between adjoining tubes. There was not enough metal to allow a proper boiler patch to be placed. An oxyacetylene welding outfit and operator were obtained from a local garage, and, following the advice of this operator, the crown sheet was welded out in the open. The temperature was about 35 deg. Fahr., and a cold wind was blowing. The weld, made with soft iron, looked rough but solid when finished, except for slight cracks, which the operator said were only on the surface. Next morning when water pressure was applied the weld did not hold. It was found that the metal had not fused and could be picked out. The cracks were from $\frac{1}{8}$ to $\frac{3}{8}$ in. wide, and the metal was so burned that no further welding could be attempted. The boiler was taken to a boiler shop, but nothing could be done with it and it was scraped. The shop foreman said that the crown sheet could probably have been successfully welded in the shop, where the heat of the flame could be conserved and the crown sheet allowed to cool very slowly to prevent cracking.

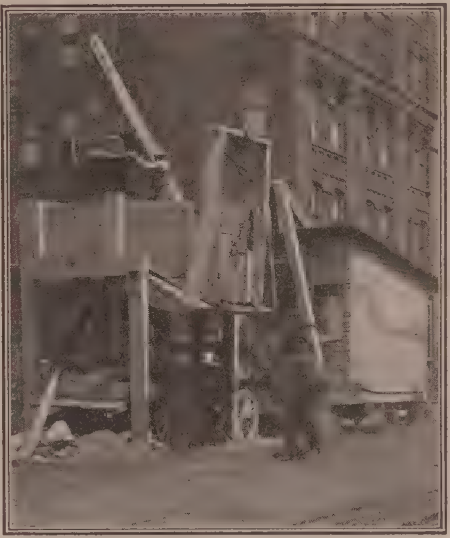
In another case, also during cold weather, the valve chest cover of a horizontal steam engine cracked, and an operator, also from a local garage, attempted to weld it with an oxyacetylene outfit. Although the work was done under cover and the steam chest was heated by steam before beginning, the weld was unsuccessful because of lack of proper facilities for conserving the heat. There were no serious results from this failure, however, and the crack was successfully repaired with Smooth-On under a patch fastened with cap screws.

A third experience with the oxyacetylene flame was in cutting off a steel cylinder 3/16 in. thick and 3 ft. in diameter. This cylinder was in the bottom of a circular sewage-disposal tank under construction, where it was used as a sump. After the bottom of the tank had been concreted around the cylinder, the latter, which stood a foot above the concrete, had to be cut off. The cylinder was full of running sand and water, which was slowly overflowing its top. Cutting was started with a sledge and cold cutter, but the striking brought in more material, and was suspended for fear of a run-in. An oxyacetylene outfit and operator were obtained, but after five minutes of application no appreciable impression had been made on the metal. The sand and water in the cylinder were then shoveled out and kept about 4 in. below the line of cutting. The operation was then quickly and successfully carried out. The sand and water against the inside of the cylinder had conducted the heat away so quickly that the metal would not fuse.

These experiences make it evident that the heat of the flame must be properly conserved in order to get results.

Portable Hoppers on Street, Steam Shovel Underground

A REVOLVING steam shovel is at work under Seventh Avenue in New York City taking out a full-depth rock heading on Section 4 of Routes 4 and 36 of the new dual subway system. It drinks only water and is on the job promptly at 8 each morning. The superintendent for the Litchfield Construction Company, contractor for the section, has not worried about the prevailing shortage of muckers since it was installed. It handles rock from the entire face faster than the rock can be shot down, loading with its $\frac{5}{8}$-yd. dipper "battleship" skips handled on platform cars by mule. The street over the shovel is supported on 40-ft. girder beams carried by towers built inside of cribbing which could support the load alone, and which amply protects the vertical timbers inside during blasting. The steam shovel is provided with a square shield of 3-in. plank, behind which it takes refuge when blasts are fired.



HOPPER WEDGED UP IN USE

The heading is advanced by the needle-beam method. As the rock is overlaid by 8 to 10 ft. of clay, the most economical way to operate is to remove the clay first and take the rock out in a second lift. It was not possible, of course, to take out this clay at the construction shafts. To remove it by hand loading as the street was decked would have been very wasteful. Therefore temporary shafts have been opened at convenient points along the curb by cutting a hole in the decking and pulling up one of the derricks and one of the loading hoppers shown in the photograph. They are mounted on wagon wheels for moving, but rest when in use on wedges driven far enough under their frames to raise them off their wheels. It takes but a short while to knock out these wedges, haul the outfit ahead and drive them in again. The derricks dump into the loading hoppers turn-

FORTY-FOOT BEAMS ON TOWERS PROTECTED BY CRIBBING ALLOW USE OF SHOVEL UNDERGROUND over buckets, which are hauled to the shafts by mules on platform cars running on the upper level.

Only the paving is replaced by this method in the first decking operating, the subsurface structures and the timbering above the level of the needlebeams being taken care of as the excavation to rock is taken out under the decking. The work is being done under the direction of the Public Service Commission, of which Alfred Craven is chief engineer and Robert Ridgway chief engineer of subway construction. J. W. Goodridge, vice-president of the contracting company, has general charge of the construction work.

Big Bridge Caissons Launched from Submerging Pontoon

By A. FREDERICKSON
Metropolis, Ill.

A PONTOON was used to construct the caissons for the Paducah & Illinois Railroad's bridge at Metropolis, Ill., the submerging of which is controlled by water-ballast tanks kept above the surface at all stages of the pontoon. These tanks are taken off while a caisson is being built, and are only put in place before a launching. They are filled by pumps and emptied by gravity.

The pontoon is 66 ft. 9 in. by 120 ft. 10 in. and is 9 ft. 6 in. deep. The largest caisson built in it was 60 ft. 6 in. by 110 ft. 6 in., the portion constructed before launching weighing 67½ tons. On account of the unequal distribution of the load, the pontoon is given transverse stiffness by heavy timber beams on 4-ft. centers. Each of these is made of four 8 x 16-in. timbers bolted together and spliced with steel plates. Under these beams are longitudinal rows of 12 x 12-in. timbers on 4-ft. centers. The pontoon contains 183,120 ft. b.m. of lumber and, allowing for the iron used in its construction, has a net buoyancy of 195 tons. The whole pontoon must, of course, be filled with water to reduce the buoyancy to this figure. This is done just before launching the caisson by removing a wooden gate, made in two pieces, which covers a number of 4-in. holes in the side of the pontoon. The gate is first unbolted and temporarily shored, and comes to the surface when the shores are removed. When the pontoon is raised after a launching, the emptying of the ballast tanks brings these holes above water so that the gate can be replaced.

On a deck of 3-in. plank laid between the transverse timber beams is loaded sufficient gravel to weigh 130 tons submerged. This reduces the buoyancy to a point which allows the pontoon to be sunk free of the caisson being launched when the water boxes are about half full. Each of the six boxes weighs 2 tons, is 23½ ft. long, 3 ft. wide and 7 ft. 8 in. high. Each has a capacity of 17 tons of water, but not more than 9 tons per box is required.

All five of the large caissons for the river piers were launched from this pontoon without mishap, the first being floated on Oct. 9, 1915, and the last on June 30, 1916. The caissons were built up with the pontoon moored at a dock, on which the caisson material was handled by a locomotive crane and a derrick. Derrick boats were used from time to time to assist in the work. The steamboat which towed the caissons from the pontoon to place is shown in one of the photographs.

The bridge is being built for the Paducah & Illinois Railroad Company, for which C. R. Ficks is resident engineer. The Union Bridge & Construction Company has the contract for the substructure. H. K. Seltzer is chief engineer, G. F. Wilhelm is engineer at the bridge and T. T. Newman is superintendent for the contractor.

Field-Office Accounting: Pocket Pads for Timekeeping

By BENJAMIN L. LATHROP
Of Lathrop, Shea & Henwood Company,
Scranton, Pa.

THE FEWER the books kept in a field office the better. Loose sheets, perforated and indexed in "Shannon" or similar files, facilitate a systematic arrangement of the data that should always be readily accessible. Even the pocket time book, traditionally indispensable, may be superseded to advantage by small pocket pads with detachable leaves in the accompanying form. This form is, of course, shown here in condensed shape. In actual use the blank would be considerably larger, with lines enough to provide for recording the average number of men in a gang.

The advantages of the pocket pad over the pocket time book, especially on a large job where many gangs are employed, are numerous.

If the names and numbers are recorded in a book in alphabetical or numerical order, the pages have to be thumbed over repeatedly to find each man's account before checking it. If they are recorded in groups representing each gang, the shifting of men from one gang to another confuses the record. Time-taking in all kinds of weather results, often, in records so badly blurred at the end of the weekly or semimonthly period that they are almost undecipherable. On the pocket pad, names and numbers can be recorded more quickly than the pages of a book can be thumbed over for the check-mark. Each gang's daily record is complete in compact form, and the data are taken in a form already classified for entry on the cost sheets. Furthermore, the time can be just as readily transferred to the payroll as from a time book, and changes in rate payment can be conveniently recorded.

DAILY REPORT
ARNOLD BROWN & CO.

Weather............... Contract............... Date...............
Class of work.......................

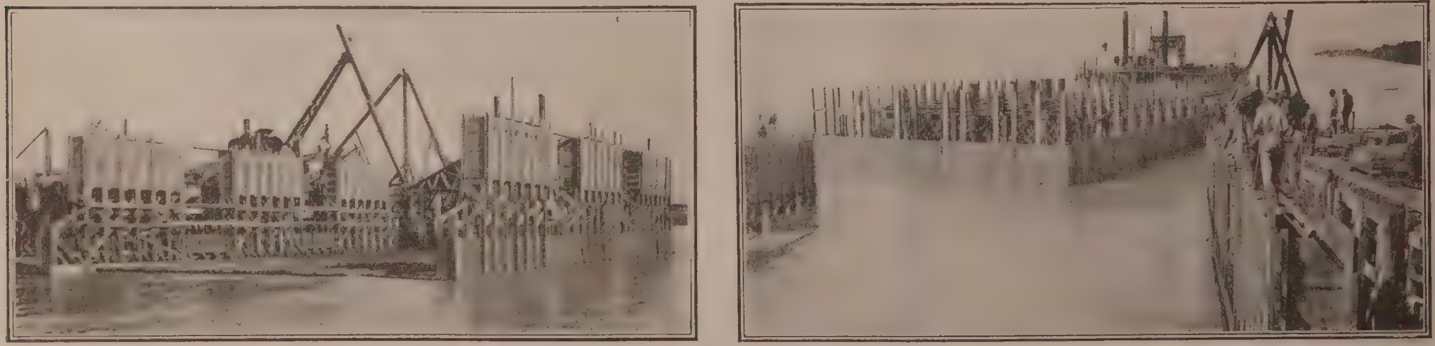
Name or No.	Occupation	Hours	Rate	Amount

Total labor cost for day,
Materials used as per memo on back hereof,
Total,

[Following the series of short articles by Mr. Lathrop on economical accounting methods for the contractor's general business, another series on short cuts that have proved valuable in the job office is introduced by the present article.—EDITOR.]

Integral Curb Cuts Paving Cost 11 Cents Per Yard

Bids on paving in Appleton, Wis., recently revealed that an integral concrete curb would save 11 cents per square yard on 9629 sq. yd. of pavement as compared with a separate curb.



PONTOON SHOWN DURING AND AFTER LAUNCHING OF ONE OF BIG BRIDGE CAISSONS—WATER-BALLAST TANKS ALWAYS ABOVE SURFACE

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Worthless Concrete Responsible for Failure at Cleveland Filter Plant

Four Columns of Clear-Water Basin Break Down Under Weight of Ground Roof Before Earthfill Is Placed Above

(EDITORIAL CORRESPONDENCE)

Concrete that was penetrated with a bull point to the depth of half an inch at each blow of a 12-lb. sledge, that crumbled in the hand and soiled the fingers, that appeared to be innocent of cement to an astonishing degree, was undoubtedly responsible for the collapse recently of four columns and the section of groined roof they supported near the east end of the central section of the new clear-water basin of the Cleveland municipal filter plant. The collapse took place even before the 3-ft. earthfill had been placed on the roof. The basin had been filled once, and was emptied at signs of trouble, the collapse taking place directly afterward.

Condition of Concrete

An investigation into the causes of the collapse, which fortunately did not result in loss of life, and into the deplorable condition of the whole structure is being made for the city by James H. Herron of Cleveland, Nathan C. Johnson and Frederic C. Noble of New York. The origin of the aggregate and sand, the inspection methods and the construction details will be gone into to fix the responsibility and to determine more accurately the cause of the faulty construction.

It was evident to representatives of the Engineering Record who examined the collapsed section and the central basin that extensive, if not entire, replacement of the substance that passed for reinforced concrete when the structure was accepted will be necessary. Reinforcing appeared at the surface in more than one column. One 22-in. square column was broken clear across through a layer which contained no stone and which could be whittled with a pocket knife. The soft sandstone pebbles which made up a large part of the aggregate were actually harder than most of the mortar in the structure. Pebbles and sand grains could be separated with the fingers from the broken pieces of columns and roof examined.

Much of the exposed surface of the entire section was in the same condition. The south retaining wall, against which earth is filled to the top, showed a large amount of seepage. A spring which would fill a 3-in. pipe was coming through the floor near the collapsed section. The investigators have already partly cut into a large number of places where the concrete is as soft as in the collapsed portion, and more than one column could probably be cut through with no more formidable a weapon than a table knife.

It is not thought at present that an earth slip could have been responsible for the failure, as there are no visible signs of any lateral or vertical displacement of consequence in the structure. Moreover, the condition of the concrete is more than sufficient to account for the failure.

CORNER OF PART THAT FAILED

It is said at the present time that the only check on the cement used was that kept by the concrete foreman, and that the pneumatic method was used on most of the central section, while a spouting system was also utilized to some extent. Since it is certain that the Walsh Construction Company, which built the clear-water basin, would not risk its reputation by willingly putting up such construction, and that the engineer of the Cleveland Water Department would never knowingly have allowed such work, the failure seems to be an example of what can be accomplished by laxity, ignorance and carelessness. It must be remembered that poor concrete can be placed with any of the methods in use, especially if next to no cement has been put in it, and if it contains more than a modicum of clay and other matter that soils the fingers when rubbed. All the facts surrounding the failure will not, of course, be known until the report of the investigators is made public; but this much is certain, that there is no reason for invoking faulty design or the geology of the foundation site to account for the failure of the sort of "concrete" with which the clear-water basin was built.

[At the time of going to press information was received that the consulting engineers will submit a repair scheme not necessitating tearing out the present structure.—EDITOR.]

Quick Repair of Dam Saves Charleston's Water Supply

Rainfall of 16.3 Inches in 24 Hours—Floods Earth Dam—Sand Bags Covered with Canvas Successfully Withstand Current

Heavy rains early last week followed by a precipitation of 16.3 in. July 21 and 22 caused the waters of Goose Creek to submerge the Charleston (S. C.) Light & Water Company's earth dam. The swift current rapidly eroded parts of the earth structure and necessitated quick repairs to save the water supply of Charleston. The first damage was done at 7.30 p. m. Saturday. The temporary repair work was completed the following Wednesday.

On Friday, July 14, the gage at the Charleston pumping station showed a rainfall of 3½ in. during the 24 hours. This followed a rainfall of more than 2 in. the early part of the week. During the 24 hours from Friday to Saturday night about 16.3 in. of rain fell. According to observations made by a contractor, the intensity of the rainfall at one time during Saturday was at the rate of 2 in. in 10 min.

Saturday the water began to overflow the spillways and run over the earth dam. Dr. J. M. Worthen, the superintendent in charge of the plant, did everything possible to prevent the erosion of the earth embankment. At 7.30 Saturday evening the water was at the highest point and still rising rapidly. It reached a depth of about 14 in. over the earth dam and the downstream slope began to erode

(*Continued on page 152, first column*)

CONCRETE COLLAPSED BEFORE LOAD WAS APPLIED

SPECIMEN OF ONE OF THE COLUMNS THAT FAILED

Quick Repair of Dam Saves Charleston's Water Supply

(*Continued from page 151*)

quickly. Within half an hour a breach was washed clear across the dam, which at that point was approximately 50 ft. wide. The breach was longitudinal with the dam, about 100 ft. wide on top and 13½ ft. deep. The top of the embankment was at elevation 13.5 ft. above ocean tide; the bottom, approximately zero. The crest of the spillways was 10½ ft. above tide, and at that point the capacity of the dam was 2,800,000,000 gal.

On Monday morning, July 17, the elevation of the water was 8 ft. above tide and on Tuesday morning 7 ft. The capacity of the dam at El. 7 was 782,000,000 gal. Ordinarily the water in Goose Creek downstream from the dam ranges in elevation from zero to 6 ft. above tide. During the heavy rainfall just before the dam broke the elevation of the water below the dam was approximately 10 ft. above tide.

Cofferdam Constructed

A pile driver and wrecking crew were secured and the first work of building a cofferdam of sand bags at the upstream end of the breach was begun Tuesday morning, July 18. The temporary structure was carried to the opposite side of the creek by 3 a. m., the next day. At that time the water was rising at the rate of 1½ in. per hour. Fortunately the high tide occurred about the time of completion, so that there was little current. However, by 8 o'clock the next morning, when the tide had receded 2 ft., the velocity over the cofferdam was so great that the sand bags began to show signs of being displaced.

For half an hour it looked as if the whole cofferdam would fail. The expedient was then adopted of covering the worst places of the bags of sand with canvas, weighting it down on the upstream side and letting it lap entirely over the structure. This proved so successful that it was decided to cover the whole cofferdam in the same way.

The cofferdam when completed was approximately 25 ft. wide at the bottom, 6 ft. wide at the top and about 120 ft. long. It has withstood successfully a flow of 6 in. of water over the top.

Considerable fear was felt among the inhabitants of Charleston concerning the continuance of the supply of water. It was thought there would be difficulty in preventing the salt tide from backing up into the impounding reservoir. On account of the quick work that was prevented.

Permanent Repairs Being Made

Permanent repairs are now being made by means of heavy piling driven clear across and on both sides of the breach. These piles are spaced 8 ft. apart. Four-inch sheet piling was driven on each side. The space within and on the sides will be filled with sand bags, after which the earth filling will be completed.

The maximum flow of the stream is said to have been nearly 20,000 cu. ft. per second when the break took place. The dam is about 2300 ft. long and built of earth. It is 12 ft. wide at the top, with up and down stream slopes 3 to 1. There are a 100-ft. spillway at the east end and another 100-ft. spillway built on cribwork near the west end. The remainder of the embankment was only slightly damaged, although the water had, for a considerable time, run over the entire structure to a depth of over 1 ft.

For several years it has been recognized that these spillways were inadequate to carry off flood flows, as their discharging capacity was only 3500 cu. ft. per second, or 70 cu. ft. per second per square mile. On Sept. 13, 1912, water ran over the dam to a depth of approximately 0.7 ft. without causing damage.

The information was supplied by J. W. Ledoux, chief engineer, American Pipe & Construction Company, Philadelphia.

House Committee Reviews Power Situation at Falls

Impressed with Urgent Necessity for Increased Diversion of Water at Niagara Falls for Power Purposes

Members of the foreign affairs committee of the U. S. House of Representatives on July 13 and 14 reviewed the power situation at Niagara Falls and Buffalo, N. Y., as guests of the Niagara Falls Board of Trade and Buffalo Chamber of Commerce. After informal conferences with officials of electrochemical industries, power companies and city authorities, the committee held a hearing at Prospect House in Niagara Falls. A mass of statistics was presented tending to show the need for the extension of the diversion limit to allow the use of the 20,000 sec. ft. as fixed by the treaty.

Some urged diversion up to 50 per cent of the cataract's flow as possible without impairing the scenic beauty of the river and as necessary for the full development of the industrial arts of the nation. Officials of electrochemical industries and power companies were given assurances that the committee is in sympathy with the movement for increased diversion so long as the scenic beauty of the cataracts will not be impaired.

Diversion of Water Is National Question

It was pointed out to the committee that the Niagara diversion is a subject of national interest and one affecting the industrial life of the United States. Especially important, it was said, has been the part the Niagara electrochemical industries have played in averting a panic that would otherwise have been brought on by the European War. Alloys essential to the manufacture of steel and high-explosive shells, as well as 80,000,000 tons of aluminum a year, are being produced at the Falls, and the supply is said to be far below the demand. Frank J. Tone, manager of the Carborundum Company, also told how his firm had to construct a plant in Canada because of lack of power on the American side.

In discussing the situation informally with Niagara Falls officials Representative Cyrus Cline of Indiana indicated that the sentiment of the foreign affairs committee on the Niagara power question is changing.

"Because of the disposition on the part of Canada to curtail the exportation of power there is a feeling on the part of the committee that the new Niagara legislation should extend the diversion limit to that provided by the treaty," said Mr. Cline.

After the Niagara Falls hearing the committee made an inspection of the properties of the Niagara Falls Power Company and the Hydraulic Power Company. They also visited the up-river districts where all the great electrochemical industries are located.

Name Canada Railroad Board

A. H. Smith, president of the New York Central Lines, Sir Henry Drayton and Sir George Paish have been named as a committee to investigate conditions of Canadian railways. Causes of railroad troubles in Canada are said to be overdevelopment, building lines into undeveloped territory and war conditions.

Agree on Grade Crossing Signal

Committees of the National Association of Railway Commissioners and the American Railway Association have agreed upon a system of signals for grade crossing protection.

The plan is to place at every grade crossing in the country a circular sign 24 in. in diameter, painted white with a large black cross in the center and the letters "R. R." inserted above the horizontal arm of the cross. The sign will be placed on the highway 300 ft. from the tracks.

When necessary, the commission recommends that the sign be lighted at night.

Five Bridges Over Catawba River Swept Away

Water Rising 48 Feet Causes Great Bridge Loss Near Belmont, N. C.—Water Receding—Damage Smaller Than Expected

As the result of the severe storm July 15 sweeping over North and South Carolina and Virginia the rivers in that section have risen to heights rivaling all past records. The depth of water at Mount Holly, N. C., is given as 47 ft. 9 in., which is nearly 20 ft. more than the record. The Congaree River July 18 was reported 31½ ft. above normal. Within a radius of 6 miles of Florence, N. C., practically every bridge has been seriously damaged, eight of those structures having spans between 80 and 150 ft.

The Catawba River rose about 48 ft. above normal, exceeding the record of 1902 by 10 or 12 ft. Probably the largest bridge loss per unit length of shore line is near Belmont, N. C. Five bridges in that section in a distance of a half mile along the river were carried away. The Southern Railway bridge on the Washington-Atlanta line was destroyed by the flood Sunday, July 16, at 5.30 p. m. Six coal cars had been placed on the structure to save it. About two dozen men were loosening the driftwood when the bridge gave way. Practically every man was drowned. At Mount Holley, one-half mile above the Southern Railway crossing, three more bridges failed that Sunday afternoon. They were the Seaboard Air Line steel bridge, the Piedmont and Northern Interurban lines structure and a steel highway bridge. Those three structures represented an investment of $125,000 and are now a total loss. The last bridge to go was the two-year-old $100,000 reinforced concrete highway bridge at Sloans Ferry.

PART OF SOUTHERN RAILWAY BRIDGE NEAR BELMONT

Build Temporary Line

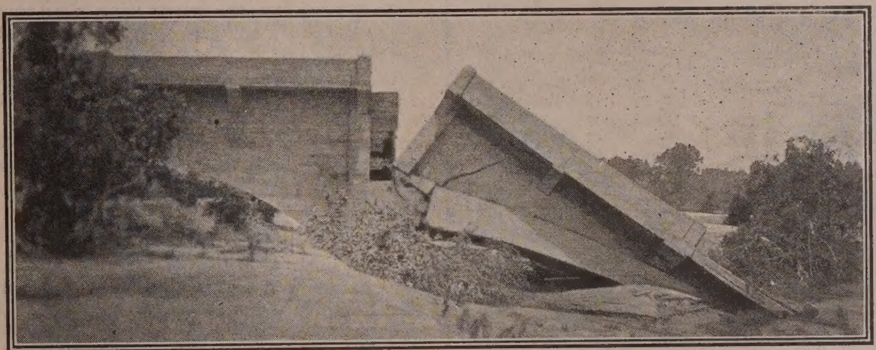
Work on putting up a temporary bridge on the Southern Railway line was started immediately. A steam shovel, three train loads of material and about 500 men were dispatched to this point. Considerable trouble was experienced getting the first few piles driven, as the water kept washing them loose. An extension of about 95 ft. had been built and filled in July 21, and the main piles in the center spans were about ready to place. Crews are working from both ends and a temporary bridge is expected to be ready in two weeks.

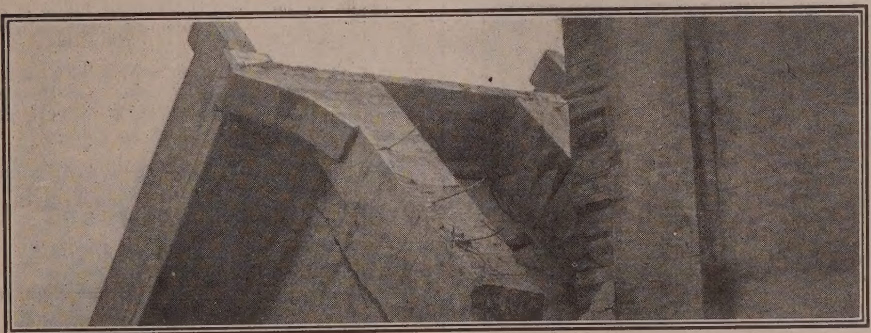
Similar work has been started on the Seaboard and on the Piedmont & Northern bridges. The Sloans Ferry highway bridge will be replaced with a temporary structure, although work had not started July 21. Rafts are being built by the railroads to carry people across the river. Passengers and mail get from Washington and points north to all points in South Carolina and Georgia by crossing the river in boats.

At Union, S. C., the Broad River changed its course after the floods receded, leaving the 6000-hp. water-power plant of the Union Buffalo mills high and dry. A dam will have to be built to throw the water back into its natural channel. The damage to that plant is estimated at $125,000. A 900-ft. trestle owned by the Union & Glen Springs Railroad crossed the river near Union. It is almost an entire loss.

The Engineering Record's representative went over the Southern Railway line from Spartanburg to Herbert, S. C., and walked 20 miles to Columbia. He found the reports of washouts and bridge trouble in that vicinity to be greatly exaggerated. The Broad River bridge was only slightly out of line and other bridges nearby held firm despite the fact that they were all practically submerged.

Reports stated that the Kanawha River at Kanawha Falls was 31.7 ft. above normal and about 38 ft. at Charles. The New River near Roanoke, Va., was reported 30 ft. above normal and the highest since 1878. At Mount Holly on the Catawba it is said that the flood crest was 47 ft. above low-water mark. The Yadkin River, near Winston-Salem, was reported 25 ft. above normal and 8.5 ft. higher than the record for the past forty-five years.


SLOANS FERRY BRIDGE COLLAPSED SUNDAY, JULY 16


"CLOSE-UP" VIEW OF COLLAPSE OF SLOANS FERRY BRIDGE FAILURE

Philadelphia Engineers' Club Enlarges Its Journal

The *Proceedings* of the Engineers' Club of Philadelphia has been greatly enlarged, conforming with the progress of the club, which has increased in membership within the last year from 500 to nearly 2500 members. The publication, beginning with the July number, is 9 x 12 in. in page size. The first issue contains 112 pages and carries a liberal amount of advertising. Each of the societies affiliated with the club, the national societies of civil, electrical, mechanical, heating and ventilating, illuminating and automobile engineers, has its own section, as has also the Technology Club of Philadelphia.

The chief feature of the first number is a series of three papers by Col. George A. Zinn, Corps of Engineers, U. S. A., on military engineering.

New York Districting Regulations Passed by Board of Estimate

On July 25 the Board of Estimate and Apportionment of New York City adopted, as modified, the proposed districting resolution in the final report of the Commission on Building Districts and Restrictions appointed in 1914, and thus enacted into law the districting regulations which have been the subject of many hearings during the past few months. The new regulations carry into effect the authorization to divide the city into regulated districts, as vested in the board by a law passed by the New York legislature early in 1914 as a result of the work of the previous Heights of Buildings Commission. The new law restricts the heights of all buildings to certain multiples (2½, 2, 1½, 1¼ and 1) of the street width for each specified district, with certain allowable mansards or vertical walls set back from the street line in a prescribed ratio.

Height restrictions and limitations of use or occupation are prescribed in so-called "use districts" and of allowable size of courts and yards in so-called "area districts." Only in the present office-building sections of lower Manhattan is a height of two and one-half times the street width permitted, and in the strictly residential sections one time the street width is made the limiting height. One of the "use district" regulations which will satisfy the public demands recently made is the prevention of further encroachment on the Fifth Avenue and Broadway retail district by loft-building factories. This district is protected between Second and Sixth Avenues as far south as Twenty-third Street. As noted in the construction-news section on another page, a record single day's total for new building permits was made just before the new law went into effect.

Practically all opposition to the general principles of the commission, which were presented in the Engineering Record of Feb. 26, page 284, was overcome, and only local changes in the proposed districts were made. The chairman of the Commission on Building Districts and Restrictions is Edward M. Bassett; Robert H. Whitten is secretary, and George B. Ford is consultant.

Gas Overcomes Many in Compressed Air Tunnel

A pocket of gas encountered late in the evening of July 24 in the landward heading from the lake terminal shaft of the new Cleveland waterworks intake caused the death of twenty-one men.

Gas, commonly encountered in underground work in the vicinity of Cleveland, has been the cause of some of the worst tunnel accidents on record. The precautions of carrying the airline clear to the working face, of providing extra compressor capacity to dilute any gas encountered and of using only the most carefully installed electric circuits for light have been in force throughout the progress of the work on the present tunnel. When the lake heading struck gas in small quantities July 22 extra caution was exercised. A sudden inrush, July 24, from a large pocket overcame the workmen before they could get to the lock. A rescue party which entered the heading was overcome and ten members could not be revived with pulmotors. The foreman of the shift, who was one of the few in the heading to survive, states that there was no explosion.

The heading, 120 ft. below lake level, had about 90 ft. of clay and gravel cover, was in "draw-knife" clay and carried 22 lb. air. It had been driven only a short distance beyond the lock bulkhead, as the lay of the job has made it economical to drive the greater part of the tunnel in one heading from the shore shaft.

The work was being done by day labor. G. C. Van Dusen, superintendent for the city, was overcome and seriously affected in rescue work. F. Farrell, commissioner of public works, and C. P. Jager have been in charge of the project for the city.

Investigate Surface Line Traffic and Capacity in Chicago

An intensive study of the traffic conditions and track capacity of the Chicago surface lines with respect to the possibilities of improved service and rerouting has recently been made by the board of supervising engineers of the Chicago traction interests. The data, which are printed as an advance reprint from the ninth annual report, show the extent and causes of the existing traffic congestion.

Stricter traffic regulations are recommended. Among these are reserved loading spaces marked in white on the pavement; electric semaphore signals; further restrictions on vehicle parking; more rigorous action against vehicles on the tracks and more drastic ordinances limiting the width of trucks and their burdens.

A modification of the standard-pavement-contour that will make it possible for teamsters to use the roadway outside of the car tracks during inclement weather is recommended. Removal of the elevated loop columns from the roadway to the curb is also advocated. In the deductions from data of fact it is stated that the present rate of car movement has exhausted the track capacity, assuming all avoidable vehicle interference removed. Even under any proposed rerouting the relief cannot last much beyond the earliest date that subways or other additional outlets will be available.

Urges Legislation to Help Exporters

The House Committee on Judiciary began hearings last Tuesday on the Webb bill to legalize combinations among American exporters seeking to extend the export trade of the United States. Chairman Hurley and Commissioner Rublee of the Federal Trade Commission advocated legislation to exempt such combinations from prosecution under the anti-trust laws.

Los Angeles Aqueduct Water Used for Irrigation

New Trunk Lines Will Bring Yearly Revenue to Los Angeles of Nearly $250,000—Estimated Cost to Complete System, $4,354,895

Surplus water from the Los Angeles aqueduct amounting to 125 sec.-ft. is now being furnished the San Fernando valley. Of this amount 100 sec.-ft. is used for the irrigation of 20,000 to 25,000 acres and the remainder for domestic purposes. The first irrigation water, delivered through an earth ditch, was supplied May 26, 1915. Plans are being made for the development of the system so that an area of 87,300 acres will eventually be under irrigation from the aqueduct supply.

While the plans for the water supply of this area call for a single distribution system, political conditions required the forming of two geographical divisions—the San Fernando irrigation district No. 3, with an area of 76,090 acres, and the Mission district, with an area of 11,215 acres.

The first named was formed in 1914, voted $2,606,000 worth of bonds in 1915 and, with the sale of these securities in February, 1916, the present work of construction was undertaken. The Mission district did not complete its organization and vote bonds until early in 1916. The issue will be offered for sale within the next few weeks, and as soon as it is sold specifications for the steel pipe required will be issued.

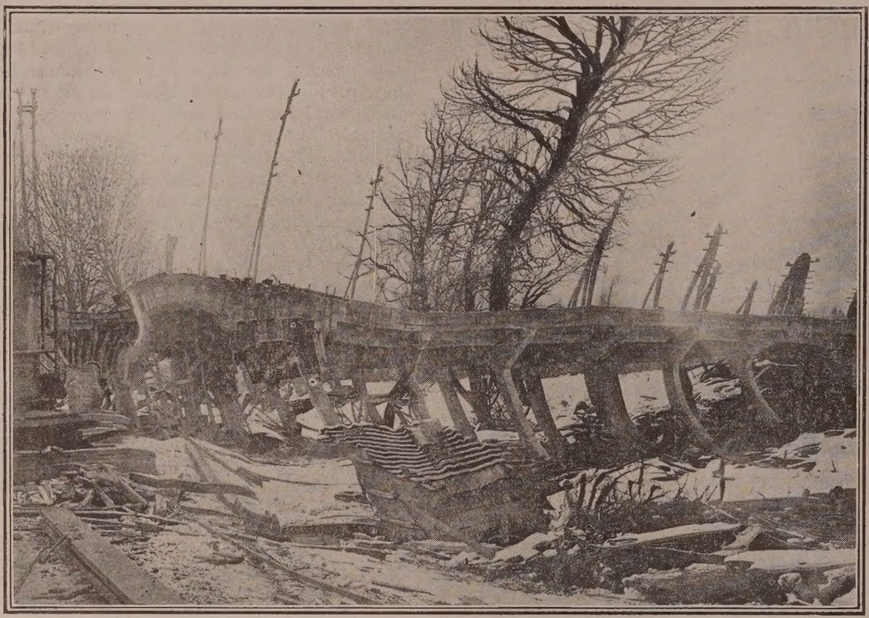
In the present scheme of development the lands are to be served by trunk lines ranging from 54 in. to 30 in. in diameter. It is estimated that 1 in. of water, continuous flow, will be required for every 7½ acres within the district. That is the equivalent of 1 in. to 5 acres for an irrigation season of 240 days. It is expected that when the district is fully served it will use surplus water to the extent of more than 11,000 in., giving Los Angeles an approximate revenue of $250,000 a year. The present sales total approximately $100,000 annually.

Contracts amounting to approximately $559,755 for pipe and materials have been awarded and bids were opened on July 10 for an additional 65,000 tons of steel pipe. In January and February, 1916, contracts for pipe calling for approximately 6890 tons were let to four Los Angeles companies, it being stipulated that deliveries were to continue for 210 days after June 1. To July 1 approximately 25 miles of trunk lines and laterals had been constructed and placed in operation.

The pipe is hauled to the valley and distributed along the ditches by auto trucks. Steam shovels excavate the main trenches, smaller laterals are dug by power excavators and a power-driven machine is used for backfilling. Thus practically the entire work is done without hand labor.

It is estimated that the total cost of completing the system will be $4,354,895. Los Angeles is paying for the trunk lines that would be needed anyway and for the Chatsworth storage reservoir to be used in the development of power. That brings the average development charge to be borne by the San Fernando valley down to approximately $33.50 per acre.

The work is being done under the direction of the Los Angeles Water Department, of which William Mulholland is chief engineer.



Sometimes Photographs Lie

THIS ONE, for instance, might be taken for a picture showing the unbelievable results of a terrific hurricane of unprecedented force. The bridge columns appear to have been bowed beyond any known elastic limit. Even the trees and telegraph poles have assumed marvelously surprising forms. The explanation is simple—the negative was exposed to intense heat in drying and the sensitized coating shrunk in such a way that the above print was obtained.

Charles D. Calley, who is bridge engineer in the King County, Washington, engineer's office, supplied the print.

Will Hold Conference on Co-operation

The third annual Babson conference on co-operation will be held at Wellesley Hills, Mass., Sept. 13, 14 and 15. The purpose of the conference is to discuss co-operation between competing business interests and between employer and employee. Previous conferences have been very helpful, being participated in by responsible officials of such organizations as the B. F. Goodrich Company, the E. I. du Pont de Nemours Powder Company, the Stetson Shoe Company, the U. S. Rubber Company, the Dennison Manufacturing Company and Fels & Company. The sessions on co-operation between employer and employee have been especially helpful.

Washington Water Code Discussed at Conference in Tacoma

At the recent meeting at Tacoma of representatives of commercial, transportation, engineering and industrial bodies of the State of Washington the drafting of a water code was the principal subject of discussion. The morning of the first day of the conference was devoted to the usual preliminary business. That evening and all of the following day were given to the discussion of water legislation in Washington.

The principal discussion was on riparian rights. The feeling on the part of those who had heretofore opposed the code was that if the riparian-right doctrine is to be abrogated due compensation should be made. In this respect the idea prevailed that the state should condemn those rights as required and permit the courts to determine their value. A committee will present a revised code at a conference to be held in November at North Yakima.

In Washington the courts have ruled that the riparian owner has the right to insist that the water continue to flow past his property without any change. That decision has held up several large irrigation projects as it prevents storing of flood waters or the control in any manner of the natural flow of the stream without first securing the consent of the riparian owners.

They Called It Civil Service

"Ben Estil, of the old civil-service board, held an examination for rodman. The members of the new board had occasion to refer at their meeting yesterday to the eligible list created by that examination. Here is what they discovered:

"An express driver for fourteen years made a grade of 90. A groceryman made a grade of 84. A draftsman, with three years' experience, made a grade of 65.

"'I think we had better abolish that list,' said John E. Wilson, member of the board. That matter will come up for a vote at the next meeting."—*Kansas City Star.*

What Engineers and Contractors Are Doing

Walker S. Gefvert, formerly with the Bureau of Standards at Washington, conducting tests on lime and cement, has been appointed to an engineering position with the Bureau of Lighthouses. He is stationed at Tompkinsville, N. Y., supervising the erection and repairing of light stations. Mr. Gefvert was graduated from the University of Pennsylvania in 1911. A brief experience in sewer construction and railway maintenance was followed by his appointment as resident engineer for the Victor Irrigation Company of Kansas City.

Leander Dorsey has resigned as superintendent of the Whiting-Turner Construction Company to become manager of the contracting department of the Crann Engineering Company, Baltimore, Md. Mr. Dorsey is a graduate of Rensselaer Polytechnic Institute, class of 1899. For five years thereafter he was connected with the engineering department of the Mexican National Railroad, resigning in 1903 as track engineer, in which capacity he also had charge of the 1100-ft. La Magre tunnel. He returned to the East in 1904 to become chief of party on surveys for the Burnt District Commission of Baltimore. Mr. Dorsey was later made assistant engineer in charge of surveys for the Elk River Coal & Lumber Association.

Frank L. Bolton has resigned as assistant engineer for Gardner S. Williams, consulting engineer, Ann Arbor, Mich., and is now resident engineer on the Mill Creek flood-control works at Erie, Pa., reporting to Farley

Gannett, consulting engineer, of Harrisburg, Pa., who has general charge of the work. Mr. Bolton was graduated from the civil-engineering department of the University of Michigan in 1909. Previous to becoming associated with Mr. Williams he was on the engineering staff of the Rochester (N. Y.) Railway & Light Company.

J. H. Piotrowsky, formerly with the Akron (Ohio) city waterworks, has been made superintendent of the waterworks at Barberton, Ohio.

James Munn, superintendent of construction for the U. S. Reclamation Service during the erection of the Arrowrock dam, is now superintending the construction of a multiple-arch dam near Salt Lake City. The structure will be about 150 ft. high and furnish storage for the city's water supply. Parrott Brothers, contractors, of Salt Lake City, are doing the work.

F. L. Lacaff, superintendent of construction of the U. S. Treasury Department, has completed the $2,000,000 Federal Building at Denver, Col. He will be located at Newport, R. I., during the erection there of a $250,000 post office and custom house.

G. C. Brooking, formerly with the Interstate Commerce Commission, Division of Valuation, Eastern District, has joined the engineering department of the Pennsylvania Railroad. His headquarters will be at Pittsburgh. Before his service with the Interstate Commerce Commission Mr. Brooking was assistant engineer on surveys for the Baltimore & Ohio Railroad at Baltimore.

Milton B. Morgan has been promoted from assistant engineer maintenance of way for the Illinois Central and Yazoo & Mississippi Valley railroads to district engineer of the latter road, with office at Memphis, Tenn. Mr. Morgan was promoted in 1912 from roadmaster for the Illinois Central to the position he now leaves.

William G. Arn, formerly roadmaster of the Indiana division of the Illinois Central Railroad, has been made assistant engineer maintenance of way of the Illinois Central and Yazoo & Mississippi Valley railroads, succeeding M. B. Morgan. Mr. Arn was graduated from Rose Polytechnic Institute in 1897. After three years' varied experience with different roads he went to the Louisville & Nashville. He rose to the position of roadmaster and left in 1906 to become local superintendent for the Southern Bitulithic Company. After about eight months in that position he again entered railway service as assistant engineer for the Missouri Pacific. He has been with the Illinois Central since 1907.

G. A. Haggander, whose recent appointment as bridge engineer for the Chicago, Burlington & Quincy Railroad was noted in last week's issue, has been with that road since his graduation from Armour Institute of Technology in 1907. He was born at Sioux City, Iowa, in 1885, and before completing his college course was employed on various engineering projects. Upon graduation he entered the engineering department of the Burlington as draftsman. He was later made concrete inspector and his appointment as designer followed shortly. In 1910 he became office engineer. His appointment as assistant bridge engineer of the lines east of the Missouri River followed in July, 1912.

Dan W. Thrower, formerly district engineer for the Yazoo & Mississippi Valley Railroad at Memphis, Tenn., has been made assistant valuation engineer for that road and for the Illinois Central, with headquarters at Chicago. Mr. Thrower entered railway service in 1900. He was assistant engineer on various divisions of the Yazoo & Mississippi Valley Railroad, preceding his appointment as roadmaster on the Iowa division of the Illinois Central. He was later transferred to the Memphis division of the Yazoo & Mississippi and then to the Illinois division of the Illinois Central. In 1913 he was made assistant engineer maintenance of way at Chicago, following which he became district engineer of the Yazoo & Mississippi Valley, with office at Memphis.

F. A. Torkelson, formerly city engineer of Wauwatosa, Wis., was recently appointed to a similar position at Green Bay, Wis. Mr. Torkelson is Green Bay's first city engineer under the commission form of government. After graduation from the University of Wisconsin in 1910 he was made assistant engineer for the Chicago & Wisconsin Valley Railway, a proposed electric line from Madison to Merrill, Wis. He left the employ of that company to join the Wisconsin Railroad and Tax Commission as assistant engineer. He was later engaged on construction with the Milwaukee County highway commission and on railroad work with the Chicago, Milwaukee & St. Paul. For the past three years he has been city engineer for Wauwatosa, a suburb of Milwaukee.

George F. Wolfe has left the employ of the Pittsburgh Bridge & Iron Works at Rochester, Pa., to take a position with the Pittsburgh Steel Company at the Monessen office. Mr. Wolfe is a graduate of Lehigh University.

W. H. Simons has opened consulting engineering offices in the National Realty Building, Tacoma, Wash. Mr. Simons has had several years' experience with the Northern Pacific and the Spokane, Portland & Seattle railroads.

George A. Ricker, consulting engineer, of Albany, N. Y., and formerly first deputy commissioner of the New York State Highway Department under the Carlisle administration, has taken charge of the office which the Portland Cement Association has just opened in the Commerce Building in Kansas City.

Moon & Barclay, contractors, of Marshfield, Ore., have dissolved partnership. The affairs of the company will be assumed by Mr. Moon.

J. E. Johnson has been made highway engineer of Osceola County, Florida. His headquarters will be at Kissimmee.

M. Earle Rochford, who has been associated with Brown & Tobish for the past three years, has resigned to go to the Trenton (N. J.) Engineering Company. Mr. Rochford is a graduate of Rutgers College. He was formerly engaged in municipal and farm engineering in New York.

Frank H. Trow, for the past eight years chief engineer for Winston & Company on the construction of the Olive Bridge dam, the Beaver Kill dikes and other contracts in connection with the Ashokan reservoir, is now in charge of grade crossing elimination at Roxbury, N. Y., for which his company has the contract.

John Williams has resigned as junior assistant engineer for the New York Public Service Commission, First District, to join the New York Highway Department. He is employed on road construction at Canaseraga, N. Y.

J. H. Myers has been promoted from assistant engineer to assistant superintendent of the bridge and construction department of the Steelton plant of the Pennsylvania Steel Company. Mr. Myers is a graduate of Lehigh University, class of 1896. His first work was as draftsman for the Shiffler Bridge Works, Pittsburgh. He left that position in 1897 to enter the engineering department of Alleghany City, Pa., where he remained for one year. He was later employed by the Carnegie Steel Company and the Keystone Bridge Works.

Olaf Laurgaard, consulting engineer, of Portland, Ore., has been engaged by the Horse Heaven Irrigation District, at Prosser, Wash., to examine plans for a proposed 300,000 acre irrigation project, involving an expenditure of $15,000,000.

Obituary Notes

Adam Saal, a well-known central Illinois contractor, died July 16 at Peoria. He was born in Germany in 1850 and had lived in Pekin, Ill., for sixty years. Besides his contracting business, Mr. Saal was head of the Pekin Cement Products Company, the Smith Wagon Factory and a director of the Farmers' National Bank.

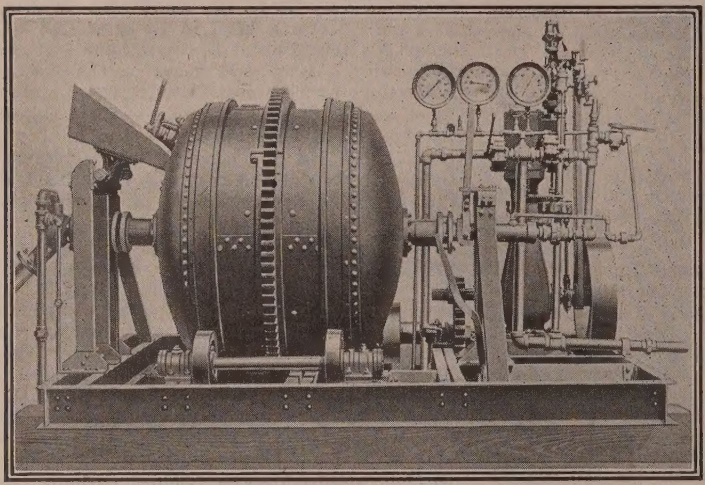
Sir William Ramsay, the discoverer of the transmutation of metals by the use of radium and one of the world's leading chemists, died July 23 at his home near London, England. He was born in Glasgow and received his education at Glasgow Academy and University. After two years in the Young Laboratory of Technical Chemistry he entered upon his career as an instructor. He joined the faculty of Glasgow University, later became professor of chemistry at University College in Bristol and then was made head of the chemistry department of the University College of London. He retired in 1913 as professor emeritus of the last-named institute. In May, 1907, it was announced by Johns Hopkins University that Sir William had succeeded in producing a copper compound from sodium, lithium and potassium by the use of radium. In London, on July 27, 1907, he admitted that he had done this and gave certain details. His discovery is said to be without parallel in the field of chemistry, as it was never thought that scientists would be able to change one element into another. He had received many honors, perhaps the greatest being that of the Nobel prize in chemistry, which was awarded to him in 1904. Sir William was a Knight of the Prussian Order Pour le Mérite, an officer of the Legion of Honor and a Commander of the Crown of Italy.

Charles W. H. Kirchhoff, for many years editor-in-chief of the *Iron Age*, died July 22 at his summer home at Wannamassa, near Asbury Park, N. J., at the age of 63. He was born in San Francisco, Cal., where his father was established at that time in the German consular service. He was educated at the Royal School of Mines, Clausthal, Germany, from which he was graduated as mining engineer and metallurgist in 1874. After serving three years as chemist with the Delaware Lead Refinery, Philadelphia, he joined the editorial staff of the *Metallurgical Review* upon its establishment in 1877. That periodical had only a brief existence. For a few years subsequently he alternated editorial connection with the *Iron Age* and the *Engineering and Mining Journal*. He was managing editor of the latter paper from 1881 to 1884, when he permanently returned to the *Iron Age* staff as associate editor. He was made editor in chief in 1889. On the death, in 1904, of John S. King, business manager, Mr. Kirchhoff added to his editorial duties those of general manager of the David Williams Company, continuing to discharge the responsibilities of both positions until the change of ownership of the company in 1909. He was elected president of the American Institute of Mining Engineers in 1898, and his fellow members thought so well of what he had done for them in that period that in 1911 they bestowed upon him for the second time the honor of the presidency. He was called upon by the United States Geological Survey to collect the annual statistics of the production of copper, lead and zinc and acted as special agent in that capacity for a period extending from 1883 to 1906. He served in an official capacity on committees organized to receive and entertain the members of the Iron and Steel Institute and of the Verein Deutscher Eisenhüttenleute in visits to this country in 1890 and 1904. He was secretary of the American committee in 1890 and chairman of the committee in 1904.

Machine Combines Mechanical Mixing and Pneumatic Placing

After a week's final test on the new mixer and conveyor the Pneumatic Placing Company, Inc., New York City, announces that 1½-in. stone and gravel concrete has been successfully shot 300 ft. through a 3-in. steel pipe and hose in 7 sec.

The new mixer combines mechanical mixing with the pneumatic process of placing concrete. It consists of an airtight mixing drum rotated by an air-driven engine mounted upon the same base. As is apparent from the illustration, the mixer is charged while stationary. The trap door is fastened and the drum is rotated like any mechanical mixer.



NEW MIXER COMBINES MECHANICAL MIXING AND PNEUMATIC PLACING OF CONCRETE

When ready to discharge the batch, compressed air is admitted to the drum and the concrete conveyed under pressure through pipes to the forms. Flanged steel pipe is used with one or more sections of heavy hose for flexibility. The terminal length of 20 or 50 ft. of hose may be handled by one man on the type of machine shown in the picture.

This two-bag-batch machine has a capacity of 15 to 20 cu. yd. per hour. It is designed for use in the construction of buildings, culverts, abutments, retaining walls and roads. Skids or trucks are furnished as desired. Also the buyer has a choice of 3-in. or 4-in. discharge pipe. Air is furnished through a 2-in. pipe.

The Pneumatic Placing Company will manufacture the new type of mixer in 3 and 4-bag sizes.

Pressed-Steel Construction Suit Dismissed

On June 16 Judge John H. Clarke, in the United States District Court for Ohio, dismissed the suit brought by the Berger Manufacturing Company vs. the Trussed Concrete Steel Company to restrain the latter from infringing a certain patent of the former company. The infringement claimed was in certain pressed-steel products of the Trussed Concrete Steel Company. The court decided that the claim under which the suit was brought was void for want of patentable novelty.

Rolling Mill Resumes Operations

The Hirsch Rolling Mill Company, St. Louis, Mo., after making extensive improvements and alterations in its plant, has again resumed operations. In addition to its usual line the company will soon begin the manufacture of steel bars for concrete construction and tie plates. M. A. Hirsch is president and general manager; C. C. Denniston assistant to the president, and T. J. Cunningham superintendent.

D. E. Garrison Is Dead

D. E. Garrison, president of the Corrugated Bar Company, died early this month at the age of seventy-six. Since the organization of that firm in 1891 he had been its president. He was at one time head of the Vulcan Steel Works of Carondelet, now a part of St. Louis, where the Bessemer and Siemens-Martin processes were employed. Lack of a supply of iron ore of good quality made further operation impossible and the Vulcan company accordingly gave up business. Mr. Garrison then organized the jobbing firm of D. E. Garrison & Company, and for many years sold large quantities of rails to railways in the Southwest. His organization of the Corrugated Bar Company, Buffalo, N. Y., followed in 1891.

A. C. Garrison succeeds his father as president of the company. A. L. Johnson becomes vice-president and general manager and W. H. Kennedy vice-president and treasurer.

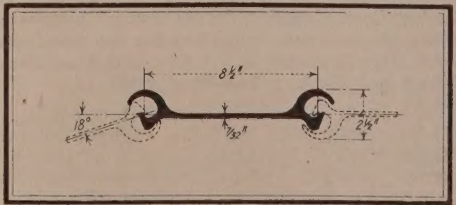
Steel Companies Combine Departments

The bridge and construction business heretofore conducted by the bridge and construction department of the Pennsylvania Steel Company and by the Pennsylvania Steel Company (of Delaware) will hereafter be conducted by the latter firm. Application has been made to change its corporate name to the Bethlehem Steel Bridge Company. The main office will be removed to South Bethlehem, Pa. The officers of the new company are: G. H. Blakeley, president; Thomas Earle, vice-president; B. H. Jones, secretary and treasurer; F. A. Shick, comptroller.

New Sheet Piling Has High Transverse Strength

A new 8½-in. section of standard straight-web Lackawanna steel sheet piling has been designed for use where a section with high transverse strength and minimum weight is required in medium trench and cofferdam work. The section was designed to give a wide range of selection.

The interlocked joint formed between adjacent piles is flexible through an arc of 18 deg. on each side of the center plane of the piling section. The hooks of adjacent sections engage to offer the greatest resistance to longitudinal displacement, while the guards overlap and engage the outer surface of the hooks on the adjacent sections. This prevents lateral and longitudinal displacement. The three lines of contact between the interlocked members of each joint are designed to give a positive, double, firm and close interlock, with a minimum of friction in driving or withdrawing and ample opportunity for displaced material to work into the joint and assist in rendering it watertight. Lackawanna steel sheet piling is made by the Lackawanna Steel Company, Lackawanna, N. Y.



NEW PILING SECTION

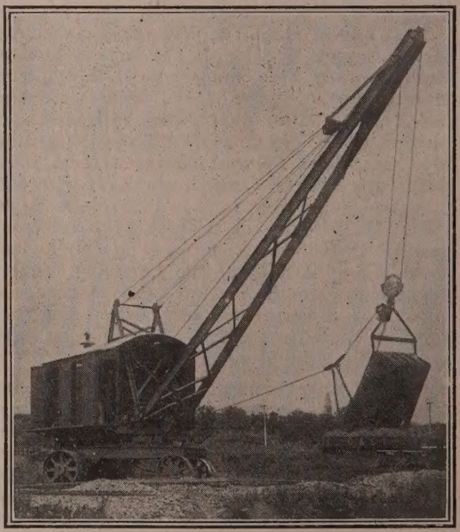
Pile Driver Base Turns with Piling—Changed Quickly

A pile-driver base that makes possible the driving of sheet piling at any angle without changing the position of the driver has been brought out by the Ferguson Manufacturing Company, New Orleans, La. It is claimed that with the Ferguson base a single-acting hammer can be used on steel piling without denting the sheeting.

The device can be changed in a few minutes to drive any kind of sheeting, thus avoiding the necessity for changing the driver. It is also said to eliminate the need for cushion blocks and pile plates. Aside from saving time and money the manufacturer states that contractors using the Ferguson base are increasing the day's work by from 10 to 20 per cent.

Air Operates Friction on Cable Drums of Small Dragline

A small dragline excavator for a 1-yd. bucket with air-operated frictions on the hoist and drag-cable drums has recently been put on the market. It also has an extra-large engine, a 70-hp. Minneapolis oil engine operating on kerosene and 42-deg. distillate. The machinery rests on two heavy girders rotating on the lower frame by rack and pinion and revolving on four two-wheeled trucks treading on a 60-lb. 8-ft. rail circle.



SMALL 1-YARD DRAGLINE HAS 70-HP. ENGINE AND BROAD-FACED WHEELS OR CORDUROY GRIPS

The excavator is self-propelled either on broad-faced wheels or on four Corduroy grips. The front axle is built up of 12-in. I-beams, with stub ends for removal in case of wear. The machine weighs 30 tons, has a boom length of 40 ft. and rotates at a speed of 2½ r.p.m. It can be equipped with steam or internal-combustion engines. It can also be operated by electrical power from an outside source or generated in the machine.

This small machine is the first of a complete line of dragline excavators the Pawling & Harnischfeger Company, Milwaukee, is building under the supervision of G. N. Crawford.